Consulting Engineer

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First, Get the Facts . . .

J. DONALD KROEKER, of J. Donald Kroeker and Associates, Professional Engineers, of Portland, Oregon, was born in Russia. The spot where he was born is now the site of the Dnepropetrovsk Dam. As Kroeker points out, his birthplace is mark-

—Continued on page 8

The Consulting Engineer's Professional Magazine

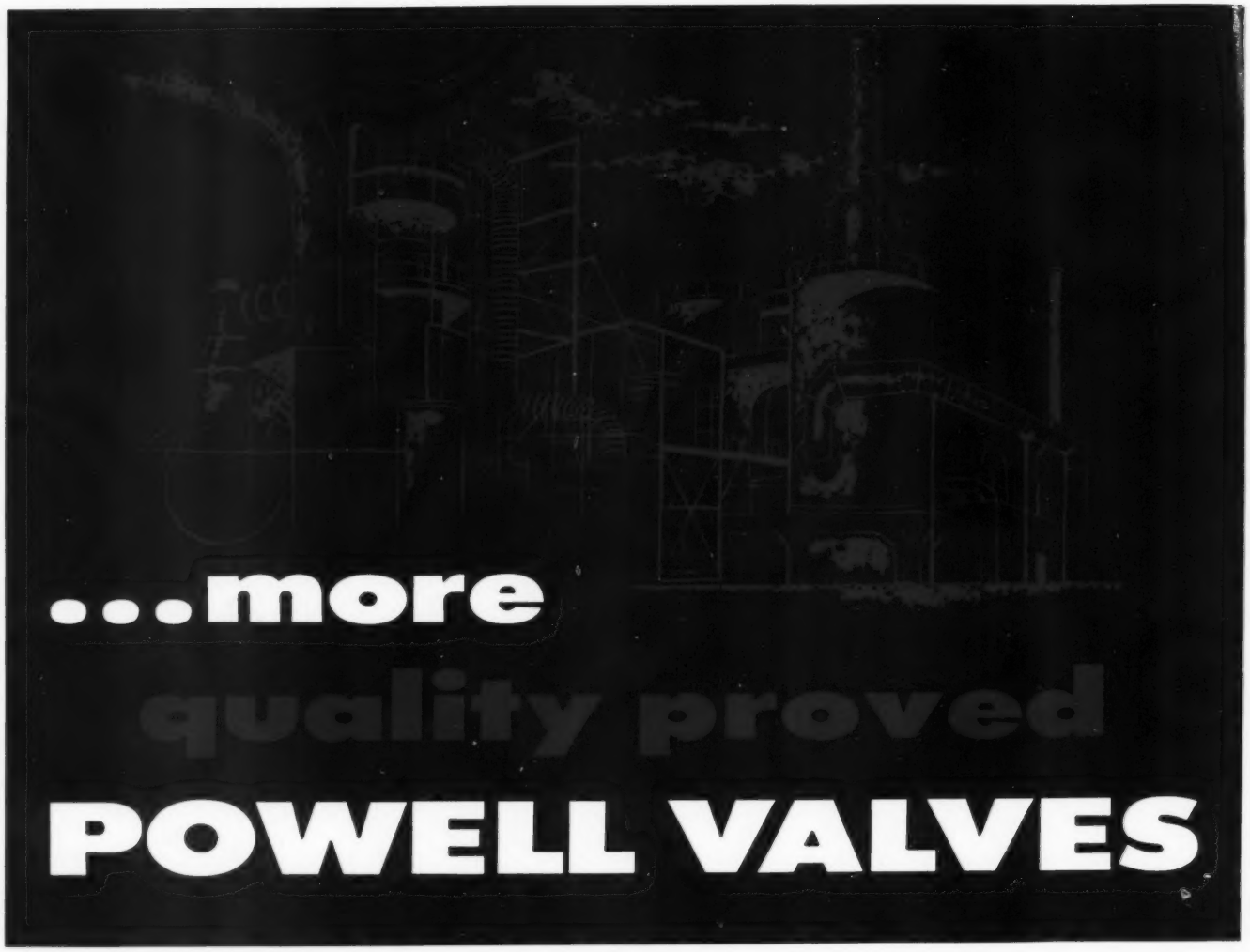


FIG. 19003—900 Pound Pressure Seal Steel Gate Valve.

FIG. 2608—Bronze "WS" Full Flow Globe Valve for 200 Pounds W.P.

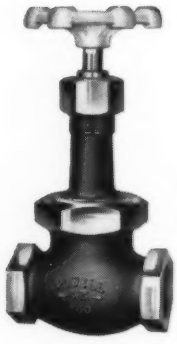
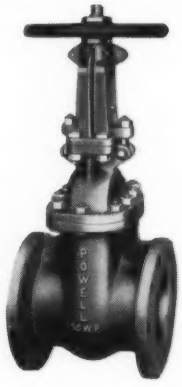


FIG. 1793—Iron Body Bronze Mounted O.S.&Y. Gate Valve for 125 Pounds W.S.P.

FIG. 2453-G—Stainless Steel O.S.&Y. Gate Valve for 150 Pounds W.P.



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Consulting Engineer

May 1957

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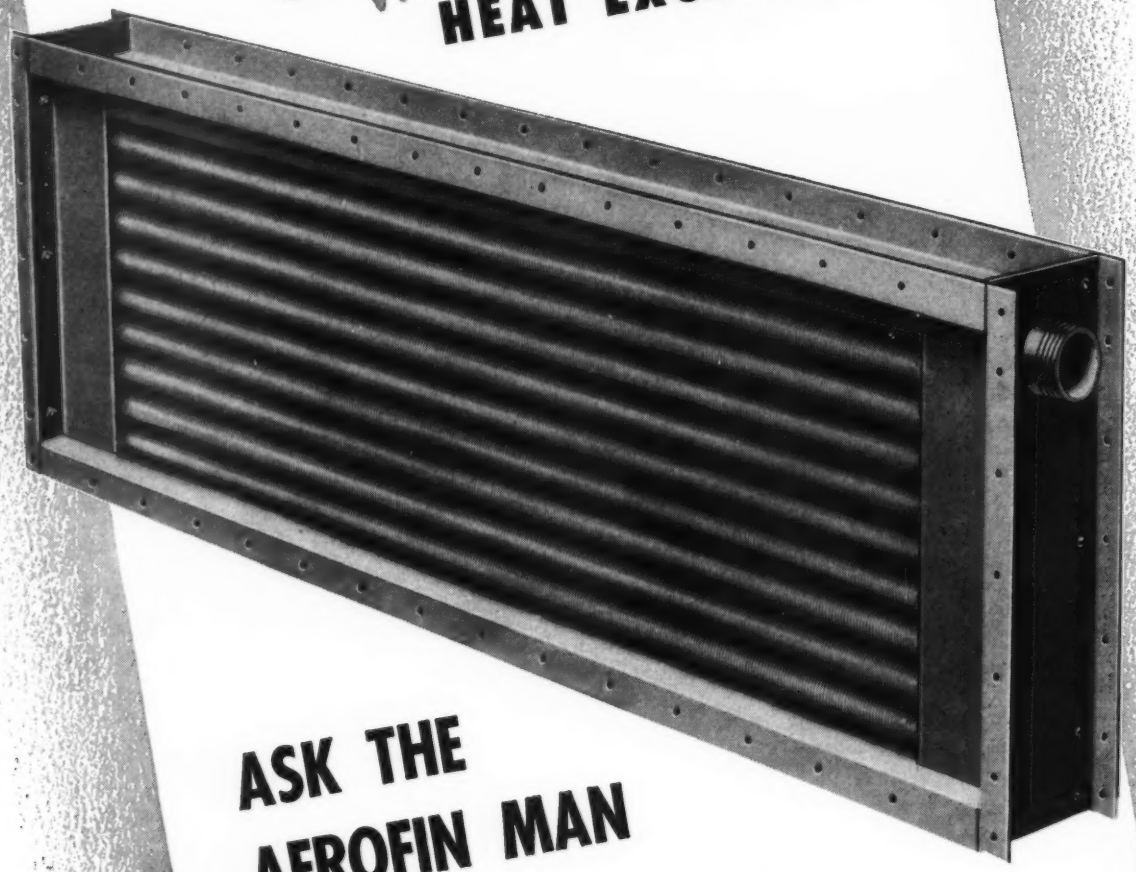

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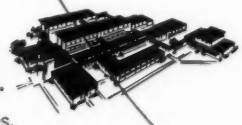

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J. Donald Kroeker

—Starts on front cover

ed by the largest hunk of concrete in the world. Kroeker's family had moved East to Russia from Germany and much earlier, in 1770, to Germany from Holland. They were Mennonites, a religious sect that had branched off from the Antibaptist, an early protestant group in Holland. Because of their pacifist beliefs they had been driven from Holland and then from Germany to the Ukraine. The Kroeker family left Russia, in 1903, for Saskatchewan, Canada, when Don Kroeker was only three years old.

While the Mennonites moved or were forced to move many times during the past 200 years, they always maintained much of their Dutch heritage. They seldom took to themselves much of the culture of the country in which they lived. The fact that Don Kroeker, born in Russia, is the son of Peter Paul Kroeker and Katharina Martens Kroeker is indicative of the way the Mennonites preserved their Dutch heritage in other lands.

J. Donald Kroeker was cast in a different mold. About the only thing about him that is characteristically Dutch or Mennonite is his name. He is an engineer; he volunteered for service in the last war and served as a Lieutenant Colonel; he wears bright red ties; and he is a Rotarian who promotes the Pacific Northwest with genuine enthusiasm.

Kroeker is president of the Consulting Engineers Association of Oregon. He is a Fellow of ASHAE and an active member of ASME, SAME, and ASRE. He is entitled to wear the keys of Tau Beta Pi, Sigma Tau, Phi Kappa Phi, and Sigma Delta Chi. A member of Delta Chi, he received his BS in CE from Oregon State, in 1927, and 10 years later his ME from the same institution.

Kroeker began private practice in 1936. He knew several architects in Portland, and he started his practice by doing mechanical design work for them. He had never been in a consulting engineer's office; in fact, it was five years before he visited in another's. There was not much of a spirit of camaraderie among consulting engineers in those days.

At the recent ASHAE national meeting in Chicago, where he was made a Fellow of the Society, Don Kroeker had good answers to the questions CONSULTING ENGINEER asked him:

Question: Mr. Kroeker, your work today, as it was when you started, is mostly for architects. Many engineers still refuse to do work for architects. Are engineers' relations with architects better or worse than when you began your practice 20 years ago?

Answer: Much better—certainly for our part of the country, the Pacific Northwest, and probably for the country as a whole. Many of the engineers who still refuse to have architects as clients would find that the conditions to which they objected have changed. From a purely technical point of view, it was not too many years ago that architects were much less cognizant of the space requirements for mechanical or electrical equipment in a building. They would draw general plans, taking into consideration only the esthetic aspects and the usable space layout. Then they expected the engineer to provide by design the heating, air conditioning, and power without any room left for these services. Utilities, apparently, were supposed to partake of the nature of a vacuum and occupy no space. Now, the comfort conditions — the environment—have become so important that architects are much more conscious of the problem. They now work with the engineer to provide adequate space for mechanical and electrical features.

The architect, trying to get the best job for the available money, no longer uses "free" engineering help from suppliers, but relies on the advice of the consulting engineer and is willing to pay for it. He acknowledges that satisfactory buildings are no longer simple structures but closely-knit and well-coordinated complex combinations of materials and equipment, requiring engineering consultants for design in various fields.

Not only that, but the engineer is given credit for his work. The client is told and so is the public. In this area, signs erected in the interest of the client's public relations on buildings under construction feature not only the architect's name, but those of all the consultants as well.

Specifications, reports, and engineering drawings are labeled as the recommendations of one of the architect's consulting engineers. In work for an architect in this area, there is no feeling that the consulting engineer is deprived of a proper degree of recognition. It is all teamwork. The coach and captain get the major credits, but all-American players frequently appear.

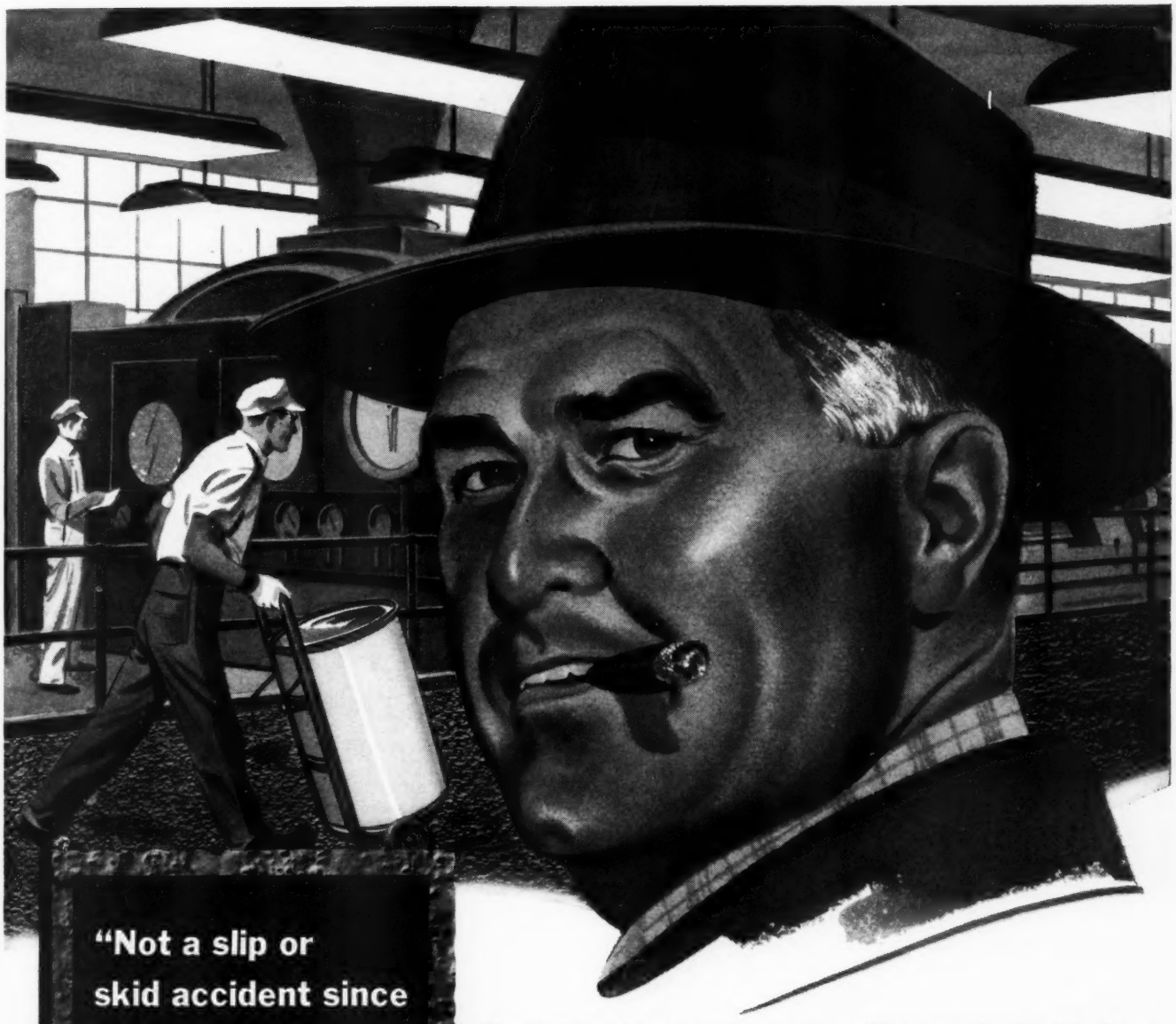
Pay is something else again. Both architects and engineers suffer. Fees have been fixed at a more or less agreed maximum and are a percentage of construction cost. The work which now goes into contract documents is tremendously greater than the increase in building costs. One need only glance at drawings and specifications of the 1920s and those of today to appreciate this difference. Major adjustments are required. It must be a joint effort.

Q. What size office do you have?

A. Ours is a small organization. Personally, I don't want a large organization. I feel that the services we render must be personal services and that I personally must be acquainted with all phases of all projects to render such service adequately. This precludes having a large office.

We have 10 engineers, and that is it. We do not have any other class of engineering employee. We have no draftsmen, inspectors, specifications writers, or other technicians or specialists.

Let's put it this way. My personal ambition is to stay out of the poorhouse while I am alive, and to



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make it possible for my family to stay out of it when, as the insurance salesman puts it, I am no longer with them. My third ambition is to help men build themselves to be self-sufficient engineers. It is about the most that I can do for the engineer and society.

Therefore, we try to make all engineers who work with us completely capable. We give them a chance at every type of work and every level of responsibility. I want each of the engineers to feel he is training himself to be capable of going into private practice for himself or going with some other firm of engineers as principal or partner. In training himself, then, each must be a draftsman, a specifications writer, report writer, and inspector. He also must adjust and write operating and maintenance instructions for each project in his charge.

All too soon, from my point of view, they leave us. I cry. But that is the way it should be. Despite our screams, we are pleased, for those men are fulfilling themselves as we planned. The one time recently that I screamed and was really hurt was when one of our engineers left us and went, not into private practice, but into industry.

Q. Mr. Kroeker, you are first president of the Consulting Engineers Association of Oregon. How did that organization get started?

A. Out of ignorance, you might say. Chet Kershaw, one of our newer consulting engineers in Portland, read an article in CONSULTING ENGINEER telling about the activities of some of the state associations. He called several engineers to see where he could get an application, and he found that no such association existed in Oregon. He and the other engineers he contacted overcame that by starting one. Now, less than a year later, we have over 50 members and an organization under way. We are a member of the Consulting Engineers Council, which accepted our application at its meeting in Atlanta, in February.

Q. We understand you have a very active association. How do you get such results so quickly?

A. I don't know about other associations. While we may be active, I am personally somewhat disappointed. Our accomplishments, I feel, are lagging. We have tried to devote our efforts to establishment of a firm background, building that adequately, and then proceeding with the many facets that must be developed to fulfill the purposes of the Association and the Consulting Engineers Council. So we have deliberately delayed certain programs. For example, after we had been formed three months, we made no further overtures to nonmember consulting engineers to urge them to join us. We felt we should first establish well thought-out criteria for membership, which took several months. Now we are again actively pursuing a membership encouragement program.

What do I mean by a firm background? Engineers, it is alleged with justification, are of a thinking profession, which approaches all things objectively. This, it seems to me, means that we should start with facts. Our first effort, then, was to take a perspective look-see. We tried to find elements common to all consulting engineer activities and their requirements which could not be fulfilled by individual effort. We analyzed to determine the extent to which existing agencies could help us. We had not had any experience, so we tried to learn what other associations find adequate to fill the gap.

Having reached this stage, it was necessary to place before the membership a coordinated analysis of problems and background, which could develop into a program. This took the form of a report of the Board of Directors. It pinpointed a number of problems and programs. There were some fields in which we still did not have facts.

For example, we listed "improved public relations" as one of our association objectives. That sounds like a fine aim. But what is public relations? Where do we stand now? What are we trying to do? We found that among our 50 members there were about 50 concepts of public relations. We had to have the facts. In this field, we felt we were not competent to find the facts, so we engaged a firm of public relations counselors who got the facts for us. The facts had to be analyzed and written down. That is the first point. Get the facts and write them down so everybody is talking about the same thing; don't just sit around and talk. The facts developed led to a program of continuing action in public relations.

So we feel we must first have facts. A next step, we feel, is to write the facts down and have an active committee proceed with development and implementation of a program. Of course, the first year you must work blind. If our Association is active, it is due to the excellent work of committees. Some men are naturally good at handling committee work; others are not. You have to find out by trying. Next year we should move ahead faster because we will know which to ask to do what.

Q. What is the Oregon Association doing now?

A. The most important job of any new association is really, it seems to me, education of its own members, particularly the ones new in the consulting field. This applies to such things as proper fees, quality of work, and ethics. Most nonconformity results, we feel, from lack of information.

Another important job of any new association of consulting engineers is to clean up the practice in the area. Conditions differ from one branch of the profession to the other. So far as conditions of practice are concerned for consulting engineers working with architects, our part of the country is extremely clean. By that I mean that contractors, architects, and manufacturers respect the specifications we write. Generally, proposals for changes in specifications and equipment not named in the specifications must be presented for approval at

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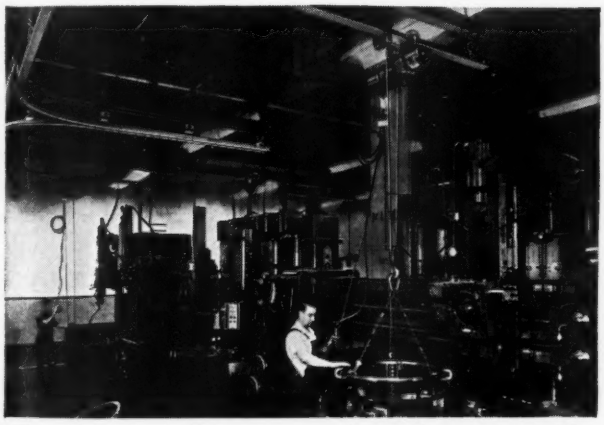

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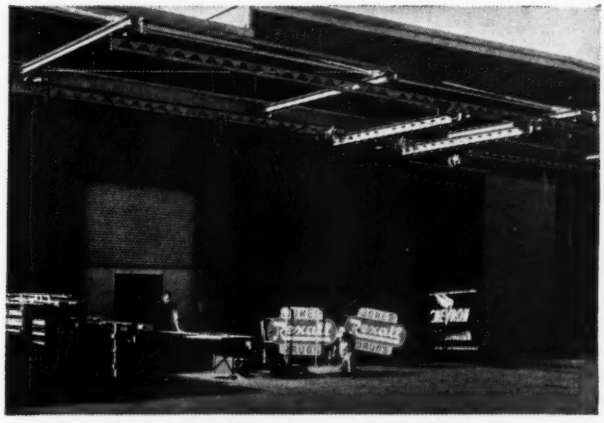

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least seven days prior to the opening of bids. That means that all contractors get a fair chance to bid on the same specifications and our writing of the specifications is not open to last minute changes brought about through a deal between a contractor and an equipment salesman.

General civil engineering is fairly clean here, too.

The structural engineers have some good and some bad spots. For example, the steel companies are now all operating aboveboard, and they do not try to give the architect "free" engineering in return for a specification. Today the steel companies are dealing through consulting engineers, as they should. The steel companies are an older industry and have established good practice.

But out here we use a lot of timber products. Manufacturers of laminated wood beams and trusses are relatively new and are, of necessity, in a strong selling phase. Often, because the beams and trusses become architectural features, they work directly with the architect, providing "free" engineering. Our Association is working on this and hopes to clean it up, too.

The consulting engineers working directly for industry also are having some troubles from "free engineering." We are getting together with the Washington State Association and the California Association to see if we can get the idea over that manufacturers cannot expect a consulting engineer to specify their equipment, if they continue to cut us out of our work by offering to do design work "free." All we want is for them to understand that we will not give away boilers or other equipment "free" with our engineering if they will not give away engineering "free" with their boilers.

There are other fields of engineering where conditions are not what we would like. Out here much of the design of certain types of industrial and process plants still is done by manufacturers, millwrights, and suppliers. We know that this is not as it should be, but that may be as much our fault as theirs. We just do not have enough engineers in private practice who have experience in some special fields — canning plant layout, for example — and if we were to go to the materials handling manufacturers or to some of the suppliers and ask them to stop doing engineering design work, construction would just about stop. We could not fill the gap with good engineering service to the client. The skill is not here yet. But it is coming.

You must remember, our Association in Oregon is not yet a year old. I am not the voice of experience when it comes to association work. But I do know one thing. We, as consulting engineers, know a lot more about each other and our mutual problems than we did a few months ago. We are getting the facts. We are writing them down. We are increasing our understanding of our own problems. We hope to solve most of them. ▲▲

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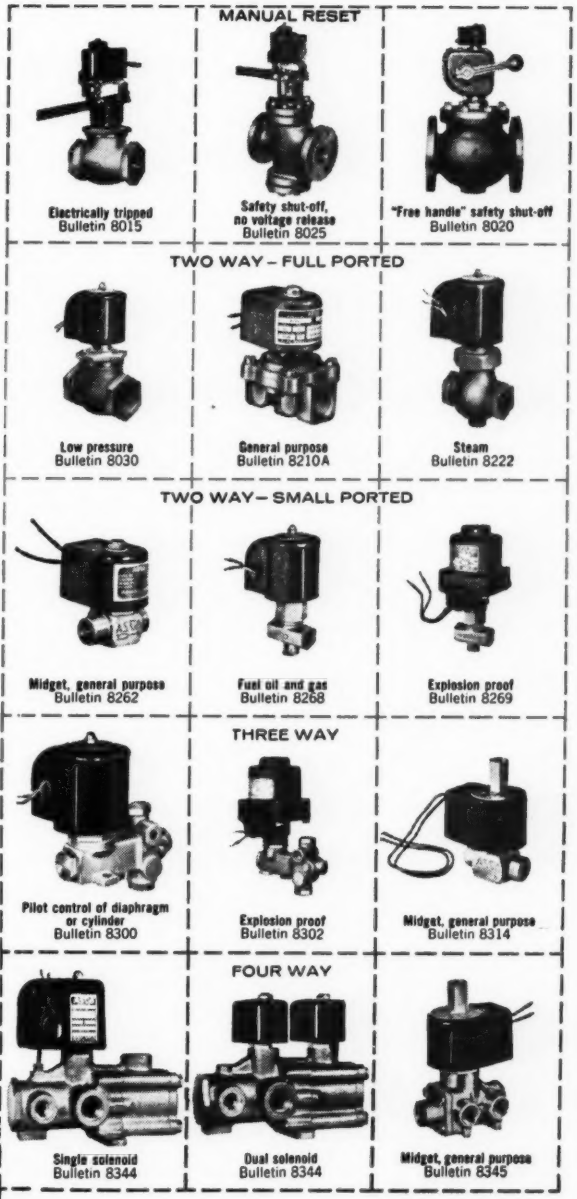
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Readers Comment

Waste Valuable Time

Sir:

The subject is "Engineers in Short Supply." Your excellent engineering magazine is equipped with the facilities to make a thorough analysis of the conditions.

I shall start you off with a number of examples of the waste of time in architect-engineering offices. It is no longer a matter of the engineer being willing to sacrifice some of his profit. It is a matter of the available time of the available engineers to do all the work planned for the entire nation.

1. I see an appalling waste of time by competent engineers in paper work and red tape. The systems should be streamlined to the absolute minimum in red tape.

2. We have the client that starts with more building area than his budget will permit. The budget is an afterthought when the estimate is submitted. The building is trimmed down and the engineer designs twice and sometimes three times. The budget should be worked out first and allocation of the various phases set up. The mechanical engineer, for example, makes his design within the money allocated. All of the allocations should be worked out under phase number one before the mechanical and electrical engineers do any design work.

3. The U.S. Corps of Engineers and the Civil Engineers Corps of the Navy are the biggest wasters of the limited engineering time that is available. Publicity of this waste of limited time is the only deterrent for the armed services.

4. A closer relationship of architect-engineering firms and a definite policy set-up could help to make the private client more realistic in his ideas on how much money he has to spend.

5. I could cite hundreds of cases of wasted time during this critical shortage of engineering man power. Sometimes it is even the fault of the architect-engineer, but in most cases it is the private client or the government agencies.

This is a thought and only a start. I am sure that you will render a great service to our nation by taking the ball from this point onward.

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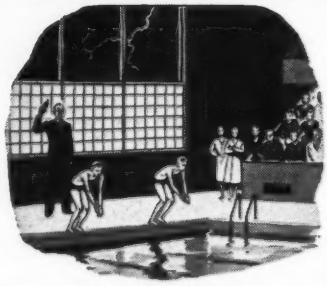

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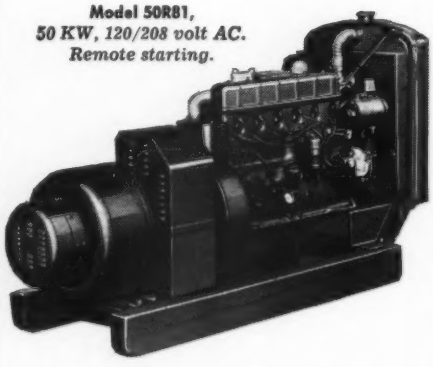
Remote starting.



Kohler Co., Kohler, Wisconsin
Established 1873

Sudden darkness in a school swimming pool may cause panic and disaster—when central station power is cut off by a storm or accident. Kohler stand-by electric plants take over critical loads automatically, wherever and whenever needed.

In hospitals Kohler plants insure uninterrupted use of operating rooms, nurses' call bells, corridor, stairway and exit lights, equipment essential to patients' care. Stores, theatres need them to maintain lighting. They prevent costly interruptions in hatcheries, greenhouses, countless enterprises. Civil Defense units need them for first aid stations, rescue trucks, mobile hospitals. Sizes 1000 watts to 50 KW. Write for specification data 21-D.

Plumbing Fixtures • Heating Equipment • Electric Plants • Air-cooled Engines • Precision Controls

KOHLER OF KOHLER

Neglected Topic

Sir:

Your January issue contained an excellent article on water treatment for buildings, a topic which we feel has been grossly neglected.

We should like to distribute several copies of this article to our clients for their general education. Please send us five copies of Dr. Sidney Sussman's article entitled "Water Treatment for Urban Buildings" . . .

Charles J. R. McClure
Charles J. R. McClure and Assoc.
Kirkwood, Mo.

"UL Approved"

Sir:

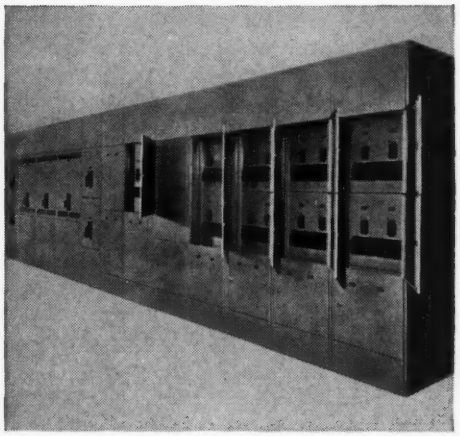
We believe an opportunity exists for you to render a service to your readers and to their clients . . . and, in fact, to the whole field of fluorescent lighting.

Recently we have been talking with some architects and electrical consultants and were amazed to find how widely they misunderstood the meaning of "UL Approved" as it appears on a ballast for fluorescent lighting.

As you know, Underwriters' is concerned only with "the examination and testing of devices, sys-

MOLDED CASE CIRCUIT BREAKERS

I-T-E plug-in mounted "Cordon" Circuit Breakers represent the maximum in flexibility, economy and safety.

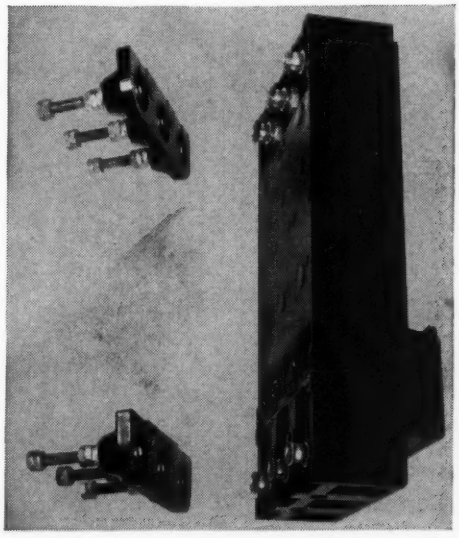


Typical switchboard installation of "Cordon" Circuit Breakers and large air circuit breakers.

I-T-E Plug-In Mounted "Cordon" Circuit Breakers Have Saved Countless Man-Hours

Plug-in mounting in switchboards provides features and advantages you get only in this modern, streamlined construction. Consider the ease of installation, the time saved in assembling switchboards. Consider the flexibility in meeting changing circuit conditions, the advantage of being able to change breakers without disturbing terminal connections. Consider, too, the added safety of concealed terminals with no live parts exposed. When you do, you'll specify switchboards with this time-proved method of installing molded case circuit breakers.

I-T-E plug-in molded case circuit breakers are available in ratings from 15 to 600 amp, up to 600 volts a-c, 250 volts d-c. Contact your I-T-E representative or leading independent switchboard manufacturers for details. Or write I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Philadelphia 30, Pa.



Used for many years in marine switchgear and approved by Underwriters' Laboratories Inc., I-T-E plug-in mounted circuit breakers require only two compact mounting blocks for switchboard installation.

I-T-E CIRCUIT BREAKER COMPANY

Small Air Circuit Breaker Division

In Canada, Eastern Power Devices Ltd.

What do you mean, "CLEAN AIR"?

Clean air is a matter of degree. Air which by some standards has been "filtered" is much too dirty for many applications. In selecting filters, one fact must be kept in mind –

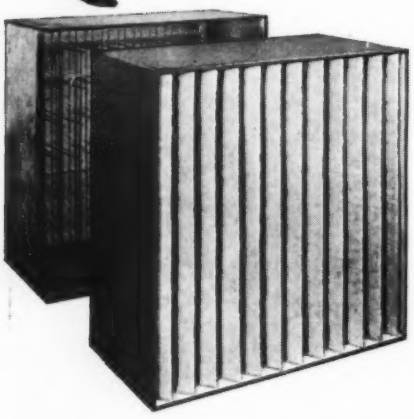
Invisible, Smudge-Producing Particles GO RIGHT THROUGH Most Filters

Only a small percentage of the dust in the atmosphere is visible. Consequently, filters which are reasonably efficient on large dust particles (see ASHVE test below) are much less efficient on atmospheric dust (N.B.S. test) and practically worthless on smoke (DOP test).

STANDARD TESTS — PERCENTAGE OF EFFICIENCY

TYPE FILTER	ASHVE (Weight Test)	NBS TEST # (Atmospheric Dust)	DOP TEST (0.3 Micron Smoke)
Cambridge Absolute	*	*	**99.95 Min.
Cambridge Aerosolve 95	*	90-95	80-85
Cambridge Aerosolve 85	99	80-85	50-60
Cambridge Aerosolve 35	96	30-35	20-30
Electronic Precipitator	99	85-90	60-70
Automatic	76	8-12	2-5
Panel	76	8-12	2-5

*Practically 100%. Test not practical for more accurate reading.
#National Bureau of Standards Discoloration Test.
**Maximum Allowable Penetration of Dioctyl Phthalate Smoke 0.05%. Every filter individually tested.



Cambridge AEROSOLVE® Filters

Available in Range to Meet YOUR High-Efficiency Needs

Cartridges Interchangeable to Meet Changes in Process or Supply-Air Conditions

The annual owning and operating costs of Cambridge Aerosolve Filters are so low that high efficiency air filtration is now practical on all process and comfort conditioning jobs. Cartridges of three available efficiencies fit the same cadmium-plated permanent frames, so that cartridges of higher or lower efficiency can be substituted without change in the filter system.

They are easy and inexpensive to install, and there is no maintenance except infrequent, easy cartridge replacement. Service life is much greater even than that of far less efficient filters.

Write for Bulletin 120

Cambridge Filter Corporation
730 E. Erie Blvd., Syracuse 3, N. Y.

Also Makers of the Famous ABSOLUTE® Filter— World's Most Efficient Air Cleaning Device

REPRESENTATIVES IN PRINCIPAL CITIES

tems, and materials as to their relation to fire, life, and casualty hazards, and crime prevention." Yet there is a very prevalent notion that UL also means a high standard of performance . . . maximum light output, full lamp life, and other virtues far afield from UL's scope of consideration.

We have discussed this with Underwriters'. They are aware of this misconception and deplore it, and we have their blessings to attempt to correct it. It occurred to us that your publication might consider this problem as being very newsworthy . . .

Don Julien
Secretary
Certified Ballast Manufacturers
Cleveland, Ohio.

Articles for Filing

Sir:

Appreciate value of CONSULTING ENGINEER very much and keep many of articles in my reference file.

It would be very fine if complete articles could be printed together, for detachment and filing for future reference.

Thanks for the magazine again and again.

L. M. Reeves, Jr., E.E.
Atlanta, Ga.

Avid Readers

Sir:

We should appreciate receiving copies of the following reprints in case they are available: "Errors and Omissions Insurance," and "Sewage Lagoons," by Mr. Williamson in your December 1956 issue of CONSULTING ENGINEER.

Your publication is constantly becoming better and more comprehensive. Many members of our firm are avid readers of it.

May we take this opportunity to express our appreciation for receiving CONSULTING ENGINEER.

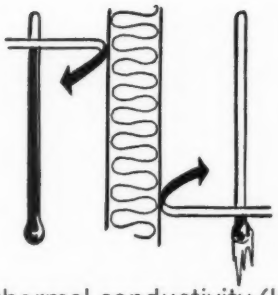
V. G. Thompson,
Engineer-Partner
Hudgins-Thompson-Ball and Assoc.
Oklahoma City, Okla.

Issue Worn Out

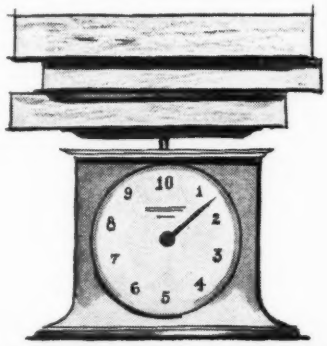
Sir:

I would appreciate it very much if you would send me three copies of the article "Sewage Lagoons are the Answer," by Joe Williamson, Jr.

This article has generated considerable interest among my various clients and my December issue of



Low thermal conductivity (k) permits use of lesser thicknesses!



Lightweight Fiberglas blocks offer economical installation, easy maintenance!

Dimensionally stable, inorganic fibers of glass will never rot, corrode, settle!

FIBERGLAS* and KAYLO®

INDUSTRIAL INSULATIONS

. . . distributed by approved Fiberglas distributor-contractors . . . offer the most versatile family of plant insulations available, in the widest range of shapes, sizes and thicknesses for every type of industrial application. With new *pink* Kaylo-*20* insulation serving the extra-high temperature ranges, you can now order—from *one* reliable supplier—complete insulation coverage *from lowest sub-zero to 1800°F.!* See *Sweet's Files, Chemical Engineering Catalog* or *The Refinery Catalog*. Or write: Owens-Corning Fiberglas Corporation, Dept. 211-E, Toledo 1, Ohio.

OWENS-CORNING FIBERGLAS

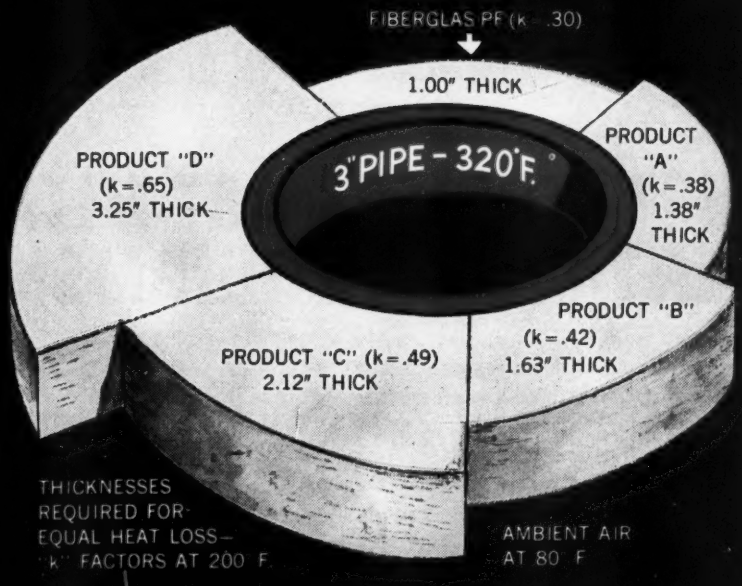
*T-M. (Reg. U.S. Pat. Off.) Owens-Corning Fiberglas Corporation
®T-M. Owens-Illinois Glass Co., Inc., mfr. of Kaylo.

Specify

OWENS-CORNING FIBERGLAS

T.M. REG. U.S. PAT. OFF.

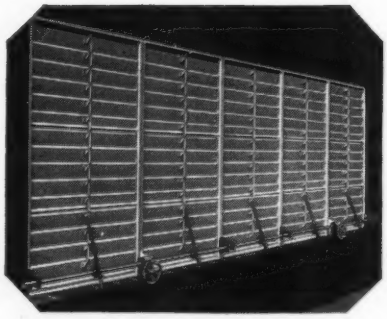
Industrial Insulations


FIBERGLAS PF (k .30)
1.00" THICK
PRODUCT "A" (k=.38) 1.38" THICK
PRODUCT "B" (k=.42) 1.63" THICK
PRODUCT "C" (k=.49) 2.12" THICK
PRODUCT "D" (k=.65) 3.25" THICK
3" PIPE - 320°F.
THICKNESSES REQUIRED FOR EQUAL HEAT LOSS— "k" FACTORS AT 200° F.
AMBIENT AIR AT 80° F

for insulating efficiency!

BURT LOUVERS ARE VITAL VENTILATING EQUIPMENT

Air removed from a building with gravity or fan ventilators must be replaced. Burt Wall Louvers, with fixed or adjustable blades, provide efficient, weatherproof air inlets. The Burt line is complete, from general purpose models to industrial types and includes removable screens, louver operators and other accessories. Burt experience and specialized equipment also provide every facility to economically construct special units when required.



Series of Burt Adjustable Louvers

Send for **FREE** *Data Book!*

Write for Burt Data Book SPV-17. It supplies quick data on Burt's complete line of modern Wall Louvers.

FAN & GRAVITY VENTILATORS • LOUVERS • SHEET METAL SPECIALTIES

The Burt Manufacturing Company

919 S. High Street Akron 11, Ohio

MEMBER POWER FAN MANUFACTURERS ASSOCIATION

CONSULTING ENGINEER has been circulated to the point where it is about worn out.

Emmet J. McDonald
Civil Engineer and Surveyor
Akron, Ohio

Can End Search

Sir:

In the March issue of your magazine we note in the letters to the editor a reference to "Errors and Omissions Insurance" reprint. Since we have searched in vain for information on this subject, we would appreciate your sending us a copy of this reprint.

A. M. Dreelin, III
Torrence & Dreelin
Richmond, Va.

Copy of '54 Article

Sir:

We are interested in obtaining from you a copy of the feature article entitled "The Folded Plate," by Milo S. Ketchum; which article appeared in the July 1954 issue of CONSULTING ENGINEER.

As consulting engineers, we subscribe to your magazine and enjoy reading it very much. We consider each issue to be highly informative and packed with refreshing thoughts.

Simon H. Diskin, Associate
Charles Payne, Consulting Engineer
North Miami, Fla.

Valuable Edition

Sir:

Will you have reprints on the articles in your April issue, namely, "Are Uncopyrighted Plans Protected," "America's Covered Bridges," and "Scraps & Shavings?"

This is a particularly valuable edition. Thank you. CONSULTING ENGINEER is getting better and better.

M. G. Kopf, P. E.
Dayton, Ohio

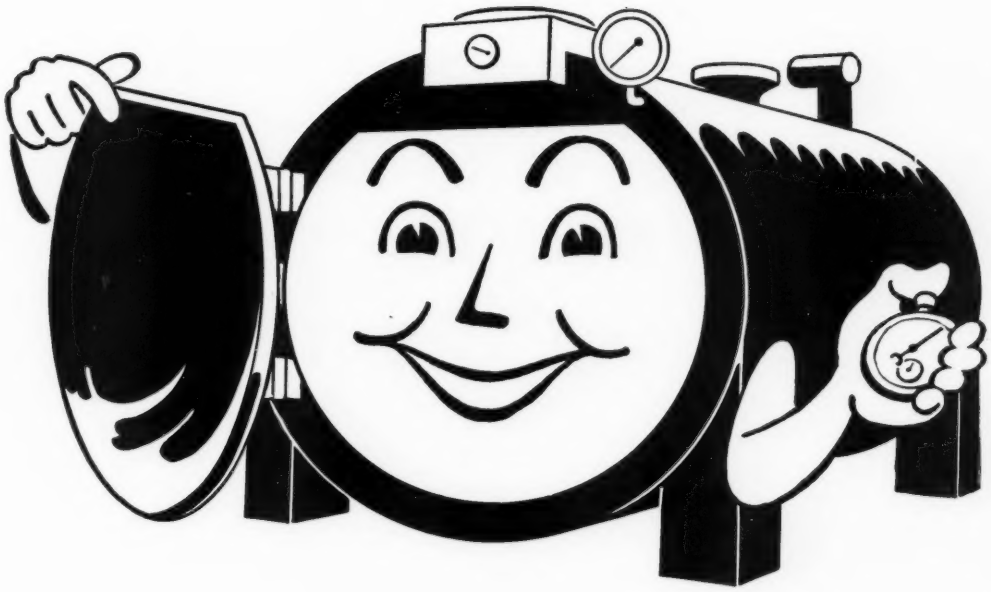
• THESE HAVE NOT BEEN REPRINTED BUT WE DO HAVE EXTRA COPIES OF THESE ARTICLES AVAILABLE.

Delighted

Sir:

Some of our members would be interested to find in our library monthly copies of your most interesting magazine.

On the other hand, it is possible that members of your editorial staff might be interested in the activities of the engineering profession within the Province of Quebec. For this



The Boiler that saves maintenance time

It's always easy to gain access to a Continental Automatic Boiler. For routine servicing, all doors — front, rear, and burner — are hinged. Simplified design eliminates need for refractory baffles or partitions which might burn out, leak, and cause short circuit of gases.

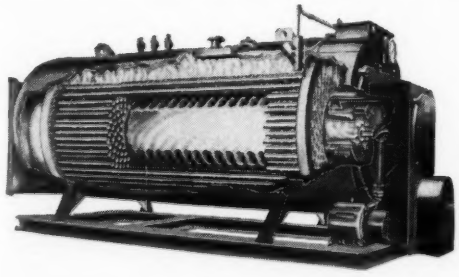
Low maintenance is one of the important cost-saving features of every Continental Automatic Boiler. Controls are simplified and dependable, requiring practically no attention. Heating surfaces stay clean, because of Continental's free, rapid water circulation. And openings are provided to facilitate inspection of steam and water space.

Continental's simple, practical two-pass design with the exclusive "spinning gas" feature means that all return tubes do equal work at equal temperatures, last longer, provide full access to all fire surfaces. And every Continental Automatic Boiler is fire-tested before shipment, to insure a guaranteed efficiency in excess of 80%, and a long, trouble-free, low-maintenance life. For more details, ask for Bulletin BE-3.

BOILER ENGINEERING & SUPPLY COMPANY, INC.

1 Manavon Street, Phoenixville, Pa.

The Continental AUTOMATIC BOILER



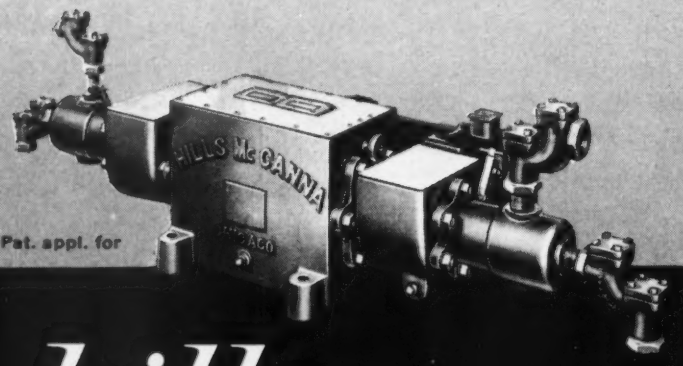
Cut-away view of typical Series A Continental Automatic Boiler, firing oil and/or gas.

A HALF CENTURY OF BOILER MANUFACTURING EXPERIENCE

Accurate Proportioning of Fluids

Hills-McCanna Metering and Proportioning Pumps

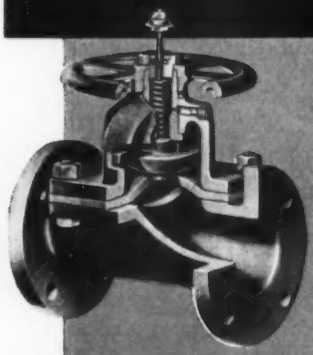
Hills-McCanna Proportioning Pumps are designed for dependable precision metering and simplified maintenance. Ranging in capacity from a few cc to hundreds of gallons per hour, they may be adapted to automatic operation. Write for the valuable booklet "Precision Proportioning Pumps" for complete information.



Pat. appl. for

hills-mccanna company

THE PEOPLE WHO KNOW AND CONTROL FLOW



DIAPHRAGM VALVES

...provide leak-tight, dependable valve performance for corrosive services, slurries, liquids, gases, air and water; feature simplified in-line maintenance, exclusive sealing bead diaphragm. Write for informative catalog on complete valve line.

Hills-McCanna Company 2446 W. Nelson Ave., Chicago 18, Illinois

purpose, I am enclosing copies of our last issues of the *Bulletin*.

We would be quite pleased to put your name on our mailing list and would greatly appreciate having ours on yours.

Pierre Bournival, P.Eng.,
General Secretary
Corporation of Professional
Engineers of Quebec
Montreal, Canada

Survey Helpful

Sir:

I really appreciate receiving CONSULTING ENGINEER. There is so much of value in it to me since I have just set up my own office. The "Survey of the Profession" is, of course, especially helpful. Do you ever ask the members of the profession for suggestions as to what the survey questions should be?

Riley Shuttleworth
Indianapolis, Ind.

• MOST OF THE SURVEY QUESTIONS HAVE BEEN SUGGESTED BY READERS, IN ANSWER TO OUR INQUIRIES OR BY PERSONAL CONTACT.

NSPE Proposal

Sir:

Your editorial ("Scraps and Shavings") in the April issue commenting favorably on Judge Hoffman's ruling that professional consulting engineering services are not within the coverage of the Wage-Hour Law is excellent, but several additional points should be noted.

First, it is not quite correct to say that the Brown case "was accepted reluctantly by consulting engineers as the last word on the subject." The Eighth Circuit decision applied only to that circuit. We know for a fact that several consulting firms in other parts of the country did not accept the Brown decision as the last word and are in court on the question. Fortunately, Lublin, McGaughy and Associates did not accept the Brown decision as final.

Nationally, the basic question remains unresolved and will so remain unless and until one of two events occurs; first, the Supreme Court issues a direct ruling on the merits, which it declined to do in the Brown case; second, Congress amends the law to clarify the point.

Congressional committees are now considering proposed revisions to the Wage-Hour Law and NSPE has testified in favor of an amendment to spell out the fact that the law does not apply to those offering and

PRUDENTIAL INSURES SNOWLESS SIDEWALKS WITH A STEEL PIPE MELTING SYSTEM

When bitter winds whip in from the lake and pile up snow on Michigan Boulevard, sidewalks and entrance areas of Chicago's great new Prudential Building will stay as snow-and-ice-free as on a summer day. They were foresightedly protected by a Steel Pipe Snow Melting System!

Automatic snow and ice melting systems are much more than a "convenience." In the snow belts of the nation, installation costs may be repaid in just a few seasons by elimination of costly manual snow removal methods. Add the advantages of accident prevention, attraction of pedestrian traffic, reduction of lobby floor cleaning costs, and you have good reasons why steel pipe snow melting is an economical investment.

Steel Pipe is first choice for such installations, as it is for radiant heating, fire sprinkler systems, plumbing, power, steam, air transmission lines and electrical raceways. In fact, it's the most widely used pipe in the world.

Send for the free 32 page booklet "Steel Pipe Snow and Ice Removal Systems."

Committee on
STEEL PIPE RESEARCH
AMERICAN IRON AND STEEL INSTITUTE
150 East Forty-Second Street, New York 17, N. Y.

Steel Pipe is First Choice

Dust Particle

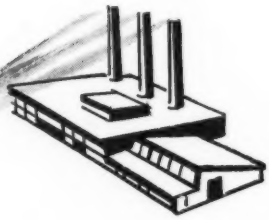
with a mission

. . . to pollute the atmosphere and damage valuable equipment.

Flyash control is more important today than ever before in history because of the ever increasing number of industrial plants in operation. Each type dust has its own physical, chemical and electrical properties. To design dust collection equipment to capture these particles requires basic knowledge of the importance of these variables to the overall problem.

The Aerotec Corporation is experienced in the quantitative measurement of all dust properties and is equipped to carry out these tests before a recommendation for equipment is ever made. This ability, plus the most advanced design of both mechanical and electrostatic dust collectors, makes The Aerotec Corporation the logical choice to solve your dust collection problems.

Our Project Engineers, located in most principal cities in the United States and Canada, will be happy to supply you with information and literature on either mechanical, electrostatic or series dust collectors.



Project Engineers **THE THERMIX CORPORATION** Greenwich, Conn.
(Offices in 38 principal cities)
Canadian Affiliates: T. C. CHOWN, LTD., 164 Metcalfe Ave., Westmount, Montreal 6, Que.

Manufacturers
THE AEROTEC CORPORATION
Greenwich, Conn.

rendering professional consulting services. We think this is the most definite and satisfactory method to dispose of the question, and if Congress adopts the NSPE proposed amendment, it will save consulting engineers throughout the country the time and expense of litigation.

Consulting engineers who wish to aid in this endeavor may secure a copy of the NSPE testimony by writing: 2029 K Street, N.W., Washinton 6, D.C., and should contact their Senators and Representatives in support of the NSPE proposed amendment.

Milton F. Lunch
Legislative Analyst
National Society
of Professional Engineers
Washington, D. C.

Covered Bridges

Sir:

The article on "America's Covered Bridges," by Richard S. Allen, is of particular interest to me.

I would like a copy or reprint of this article for my covered bridge files and do not like to break up my file of CONSULTING ENGINEER.

I take pictures of all such bridges I can find but am more interested in details of construction. It is surprising that so many of the poorly designed bridges have stood up under the loads frequently put on them — illegally.

C. W. Bell, Sr.
Engineering Consultant
Drums, Pa.

Thank You!

Sir:

I would like to take this opportunity to express my appreciation for you sending me a copy of CONSULTING ENGINEER each month.

This is one of the best magazines we receive.

J. Richard Dorsey
Runnel, Klepper & Kahl
Baltimore, Md.

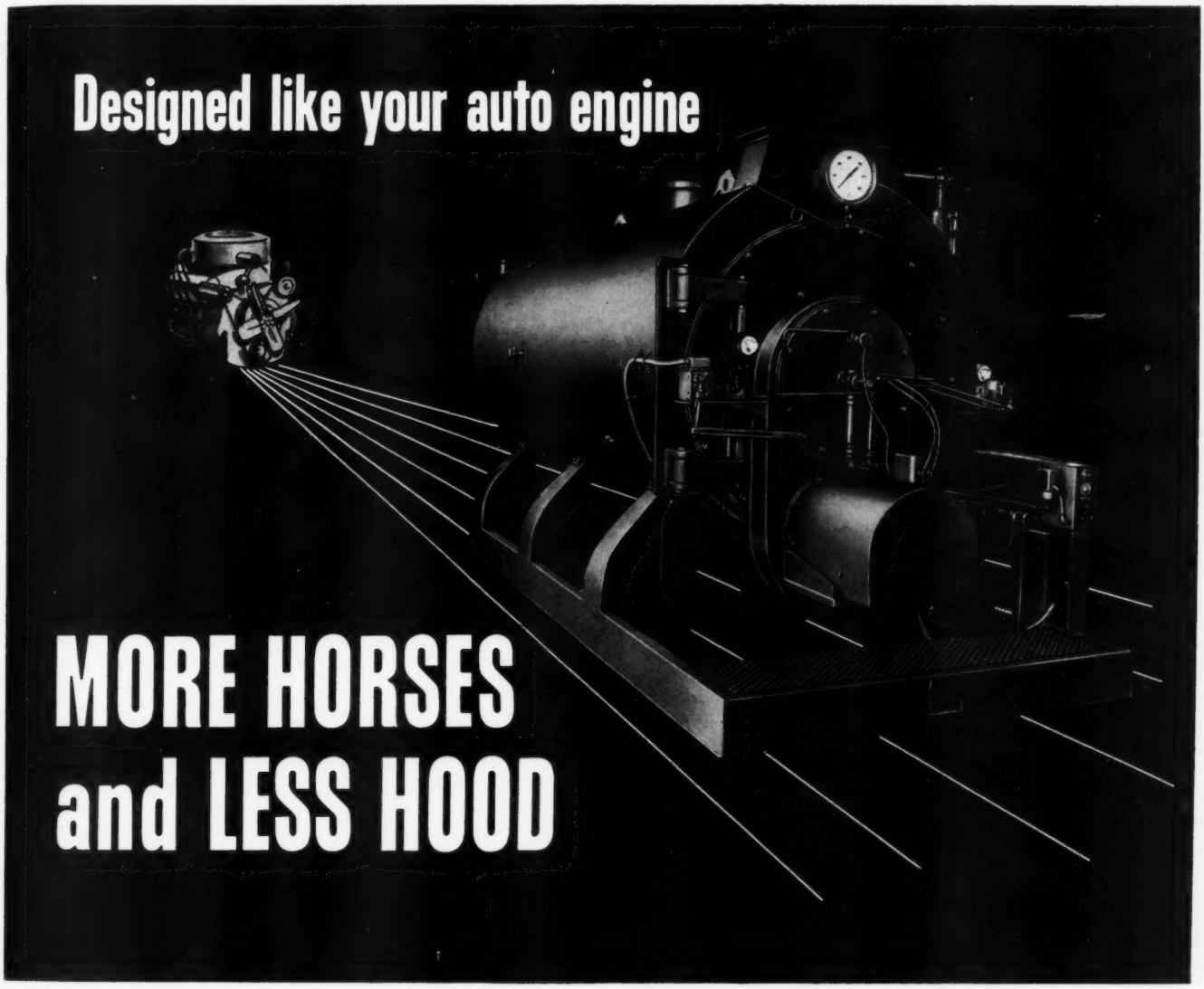
Engineering Heritage

Sir:

I enjoyed very much the article by Richard Sanders Allen "America's Covered Bridges" in your April 1957 issue. This is an entertaining and interesting resume of a portion of our engineering heritage.

It is a sad commentary on readers in general that the stimulus for a letter to the Editor is almost invariably the desire to criticize. To wit: On page 98, Mr. Allen describes — or rather mis-describes — the Pratt truss. In a Pratt truss, wood or steel,

Designed like your auto engine



MORE HORSES and LESS HOOD

Remarkable how many horses can get under the hood of today's motor car! Cyclotherm, too, represents maximum power with minimum dimension. There's no practical use for the excess weight and bulk of the conventional boiler with its maze of tubes, passes and refractory baffles. In two passes, Cyclotherm gives guaranteed minimum efficiency of 80%. The first pass utilizes approximately 65% of your fuel value; the balance is transferred in the second pass. Cyclotherm is up to ⅓ smaller than other packaged steam generators.

An electronic control system automatically operates Cyclotherm Steam and Hot Water Generators. On units of up to 60 hp, burner automatically shuts off when steam demands are satisfied, resumes when steam again is needed. On larger models, precision modulation regulates firing rate from 30% to 100% of capacity without loss of efficiency. Designed by Cyclotherm, built by Cyclotherm and assembled by Cyclotherm — a division of National-U. S. Radiator Corp. — Cyclotherm puts one manufacturing responsibility behind the entire job. Models from 18 to 750 hp, 15 to 200 psi, burn oil and/or gas. The Cyclotherm meets all state requirements and is built in accordance with A.S.M.E. and National Board Standards and bears the label of Underwriters' Laboratories, Inc.

WITH CYCLOTHERM YOU GET THESE ADDITIONAL ADVANTAGES:

- A complete, factory-tested boiler
- Completely insulated at factory
- No stack needed—only a simple flue
- No special foundation required
- Complete instrumentation
- Develops full power from cold start in 15 to 20 minutes
- Maintenance costs cut 30% to 50%
- A worldwide service organization

This 44-page book tells the complete Cyclotherm story with illustrations, diagrams, specifications and ratings. Send for it!

YEARS AHEAD IN STEAM GENERATION

CYCLOTHERM®

STEAM AND HOT WATER GENERATORS

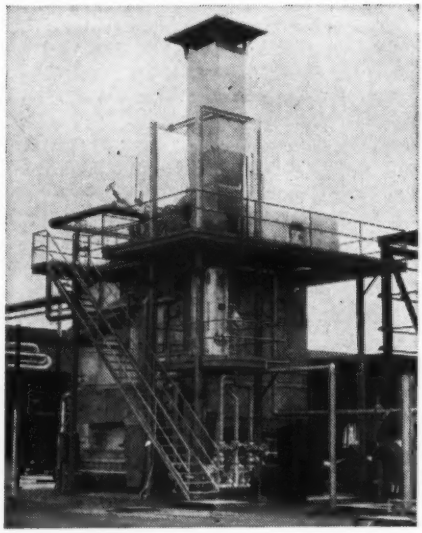
Cyclotherm Division National-U.S. Radiator Corp., 36 E. First St., Oswego, N. Y.

BROS BOILER-STOKERS SUPPLY 11 ACRES OF HEAT AND POWER AT WORLD'S LARGEST NUT PROCESSING PLANT

DIAMOND WALNUT GROWERS, INC. wanted complete efficiency in its huge, new nut processing plant. And they certainly are getting it. Take steam, for example:

This 11 acre plant at Stockton, California, uses steam for heat, steam for power and steam for its ammonia absorption refrigeration system of air conditioning.

Added to the plant's operating efficiency, walnut shells serve as an auxiliary fuel to gas; thus, a disposal problem is eliminated and a very sizable saving in annual fuel cost is made.



Meeting the 35,000 lbs. steam load at 250 psig is a Bros A-3 Boiler fired by 2 Bros Superspred Stokers. The A-3 design offers effective heating surface which generates steam quickly and responds fast to load changes . . . and also provides the minimum of furnace maintenance.

Special features of the Superspred Stokers well serve the high operating efficiencies and dependable service expected at this new plant . . . as they are serving boiler plants throughout American industry.

BROS Packaged Boilers are providing steam for heat and process applications throughout industry; capacities range from 8,500 to 50,000 lbs. of steam per hour at standard design pressures of 250 psig. Special units for higher pressures are available.

Let Bros blueprint your success with steam; the skill of 75 years in engineering, manufacturing and installation of steam generating equipment is immediately available to you through our national sales representatives.

BROS
NATIONAL REPRESENTATIVES

BIRMINGHAM . . . . . *Palmer and Lawrence*
BISMARCK, *Lignite Combustion Engineering Co.*
BOSTON . . . . . *C. B. Fuller, Jr.*
CHICAGO . . . . . *D. H. Skeen and Company*
DALLAS . . . . . *Mechanical Specialty Company*
DENVER . . . . . *Conwell-Lucas*
DETROIT . . . . . *Wayne Boiler & Equipment Co.*
DULUTH . . . . . *Williams-Swanson Company*
GRAND RAPIDS, MICH. . . . . *Clay C. Zuiderhoek*
INDIANAPOLIS . . . . . *Young-Streeter Company*
KANSAS CITY, MO. . . . . *D. E. Maskill Company*
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BROS *Incorporated*
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the verticals are compression members and the diagonals (sloping toward midspan) are in tension, except near midspan of longer trusses where stress reversal is usually produced by moving loads. Howe's truss consisted of compression members sloping downward toward the ends of the span and vertical tension members, or "hangers."

The Pratt and Howe trusses were "opposite" in respect to which members were in tension — verticals or diagonals—dependent directly upon which way the diagonals sloped. Surely none of the early "rule of thumb" bridge designers were so foolish as to attempt to subject slender iron rods to compression while wood posts were in tension! If such had been tried, the bridge would never have been built successfully and certainly no one would be writing about it today; the "designer" would long since have sunk into oblivion and his bridge into the stream.

J. C. Bridger
Wohleb and Wohleb and Assoc.
Olympia, Wash.

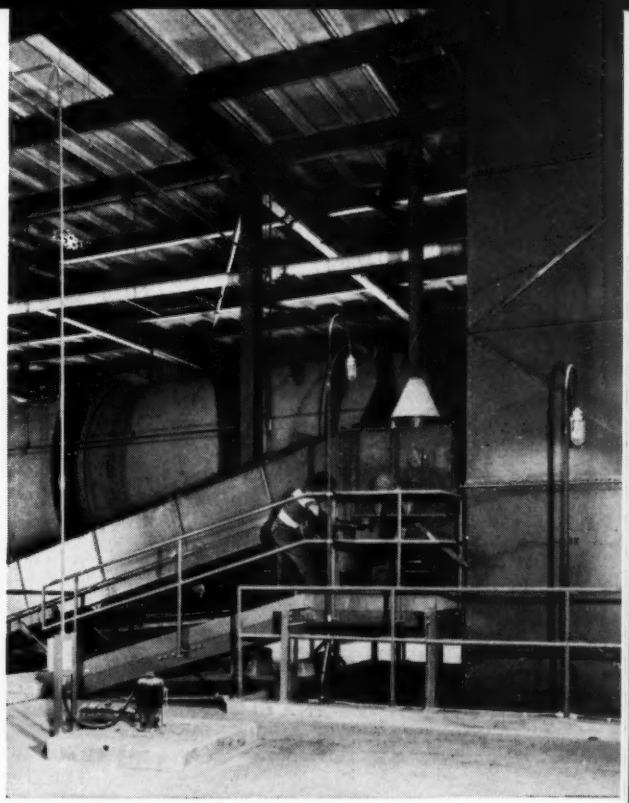
ARTICLE REPRINTS

For free copies of reprints listed below, write on company letterhead to Reader Service Dept.,

CONSULTING ENGINEER
217 Wayne St., St. Joseph, Mich.

"Dealing With the World Bank"
"Federal Highway Legislation"
"Surveying With Plane and Camera"
"Engineer De Lesseps and the Suez Canal"
"More Money for Private Enterprise Abroad"
"Gas Turbines in Electric Utility Plants"
"Curricula for Budding Consultants"
"Water Treatment in Urban Buildings"
"Precast Concrete Comes of Age"
"Survey of the Profession — 1957 — Part I"
"Survey of the Profession — 1957 — Parts II-III"
"Survey of the Profession — 1957 — Part IV"
"Sewage Lagoons Are the Answer"
"An Engineer Looks at Foreign Aid"
"Air Pollution Control"
"Better Soil Test Borings"
"Cable Trough Cuts Wiring Costs"
"Repairing the James River Bridge System"
"Higher Voltages for Commercial Buildings"

A Jeffrey vibrating feeder automatically controls the flow of material to this belt conveyor.



A belt type conveyor and a bucket elevator work in combination here to transfer materials to overhead storage bins. All components are constructed to withstand corrosive attack, thereby assuring long life and low upkeep costs.

Two Jeffrey swing hammer pulverizers are kept working at maximum capacity by Jeffrey vibrating feeders. They reduce a material by striking it while in suspension; recirculate coarser materials for greater reduction. Many patented features which contribute to efficient, economical and dependable performance are distinctly Jeffrey.

stay-ahead sales"

It pays to team up with a top-flight engineering company. They are familiar with these Jeffrey products and will advise on their use. For specific information regarding any of them, get in touch with The Jeffrey Manufacturing Company, 960 North Fourth Street, Columbus 16, Ohio.

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Scraps & Shavings

THE FIRST ANNUAL MEETING of the Consulting Engineers Council will be taking place in Minneapolis at about the time this issue of CONSULTING ENGINEER reaches the reader's desk. The Council will have been functioning for something less than a year, having held its organizational meeting in Tulsa, on July 6-7, 1956. While that is a short time in which to judge the worth of any group, thirteen state associations are now paying dues to the Council, and they as well as the currently nonaffiliated state associations are interested in what is being accomplished.

At the meeting in Denver, last September, the Council adopted a budget of $19,450 for the seven months period through April 30, 1957. This represented a payment of about $36 per member of each association in the Council. Then, at the Board meeting in Atlanta, in February, a tentative budget for the fiscal year starting April 1, 1957 was recommended. This budget would provide in the neighborhood of $18,000 and would cost the members of the various associations an average of about $35 each.

This is no great sum. If any one of the members were to take his $35 to a public relations firm or to an advertising agency and ask what they could do for him for that amount, he would be told that the interview itself had cost more than the $35. The members cannot expect much when they give so little. The National Electrical Contractors spend more money on three of their fractional page ads in *Time* than the Council will have in its next annual budget. It takes real money to do the job the Council was formed to do, and instead of $18,000, the Council should have a minimum of $180,000 a year from its current membership. This would mean dues of about $350 per year for each member instead of $35. A contractor would think that was quite reasonable.

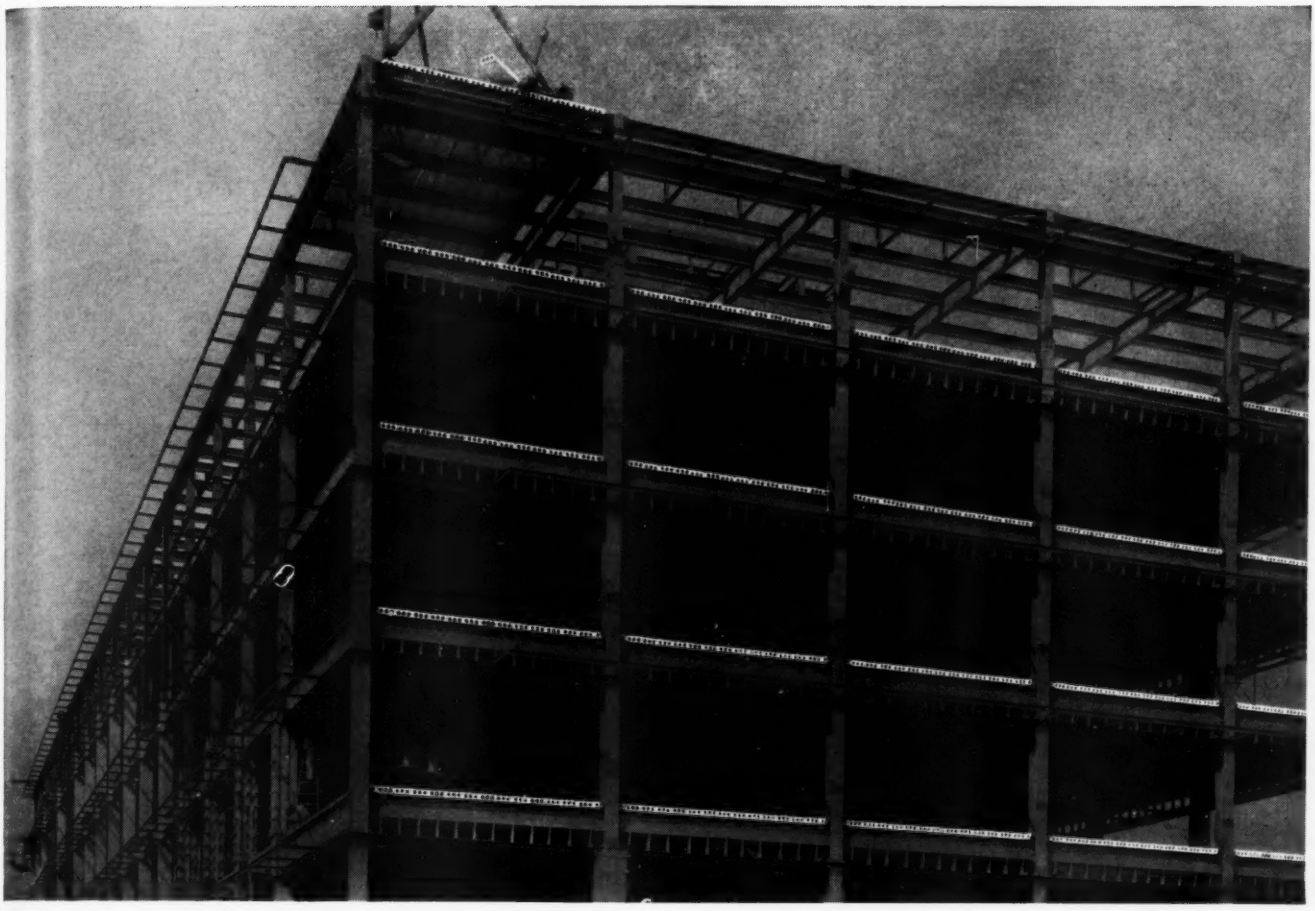
This dues problem was the most formidable of all those faced by the Council, and the Board is to be congratulated in having found some compromise to satisfy every obstacle that arose. Not only has the size of the budget been compromised, but the dues formula that determines how much each Member Association will be assessed was itself a brilliant compromise, and the Council has held together. At the end of the Atlanta Board Meeting, in February, the same ten founder associations and two charter associations were still members of the Council, and Oregon was accepted as a new member. Just two weeks ago Illinois voted to apply for membership, and it seems likely that both Washington and Texas will apply for membership shortly.

The other fundamental problem was one of membership. Would the Council accept associations that had employees of consulting firms among their members? While some of the Founder Associations and one of the Charter Associations do have associate member status for employees, it generally has been agreed that the Council is strictly an employer organization, and it is unlikely that new associations will be accepted unless they are limited to employer membership. That problem seems fairly well settled.

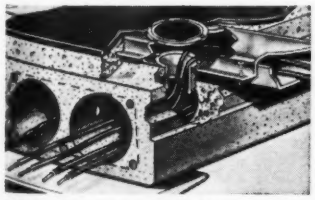
The first year, then, has been a year of organization, of planning, and of settling the basic problems of association. Many committees have been appointed, meetings have been held, and there has been discussion aplenty. Otherwise, not too much has been accomplished. There is nothing wrong with that. No more should have been expected. It is enough that these state associations have gotten together and have stayed together through almost a year. The Council is as strong as any one-year-old could be.

The year ahead is another matter. There must be accomplishments the Council can point to and say, "We did this." The members are going to expect more than talk and more than committee appointments. There is going to have to be a group errors and omissions policy made available to the members. The code of ethics will have to be printed and distributed. There will have to be a good directory of membership available to architects, industry, government, and other potential clients. An informational bulletin must be published regularly and distributed to all members of the Associations. And most important, there is going to have to be a good executive secretary in a permanent office.

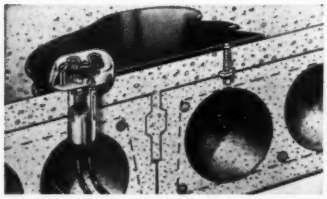
There are many other activities the Council must undertake. But the most important is the setting up of a permanent office with an executive secretary. Only when this is done can the Council really feel that it is under way. Only then can it be sure of offering its members a good return for their money. But that will take more money, and the money must come from consulting engineers. ▲▲



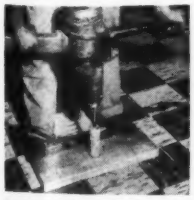
Precast Concrete Electrified Floors In New Research Building



Wiring drops from header duct into cell at handhole junction.



Wiring then runs either way through cell to floor outlet.



To install outlet: drill hole at outlet location.

Next, install fitting in floor and fish wire.

Last, attach electric or telephone outlet box.

This new engineering and research building for the National Cash Register Company in Dayton, Ohio has Flexicore electrified floors.

The steel frame structure was designed for either concrete or steel cellular floors. Concrete was selected because no fireproofing was required on the ceiling and because of other cost and time saving advantages.

In the construction picture above you can see the hollow cells in the exposed ends of the precast floors. These cells are used as electrical raceways, and electrical outlets can be installed in the floor at any point along a cell. Cells are spaced 5⅓" on centers with the 6 x 16 Flexicore unit used on this job. Conduflor electrical fittings were used to provide complete underfloor electrical distribution.

For a copy of the new 32-page Office Building Manual on Flexicore Electrified Floors, write or phone the nearest Flexicore manufacturer listed below, or The Flexicore Co., Inc., Dayton 1, Ohio.

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with Conduflor® ELECTRICAL FITTINGS

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6 GOOD REASONS WHY you should specify the NEW Acme FLOW-MIZER COOLING TOWERS and EVAPORATIVE CONDENSERS

3 Twice as much surface protection

ELECTRO-PLATED

.002" 16 GAUGE STEEL .002"

.004" OF ZINC

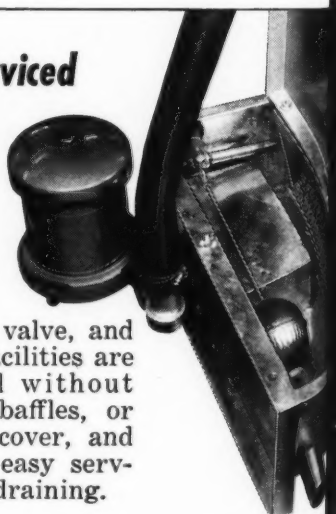
HOT-DIP GALVANIZED
AFTER FABRICATION

.004" 16 GAUGE STEEL .004"

.008" OF ZINC

The diagram shows how Acme's hot-dip galvanizing deposits twice the thickness of zinc that ordinary electro-plating does. By dipping all assemblies *after* fabrication, no surface is left exposed. With twice the protection against rust and corrosion, Acme units provide unexcelled long life . . . never need painting.

4 Easily serviced external sump



On both cooling towers and evaps, Acme's external sump provides easy access. Sediment screen, float valve, and water treatment facilities are all quickly reached without removing panels, baffles, or screens. Just lift cover, and sump is open for easy servicing, cleaning, or draining.

ACME AIR CONDITIONING REFRIGERATION

Acme INDUSTRIES INC., Jackson, Michigan

Manufacturers of Quality Air Conditioning and Refrigeration Equipment since 1919

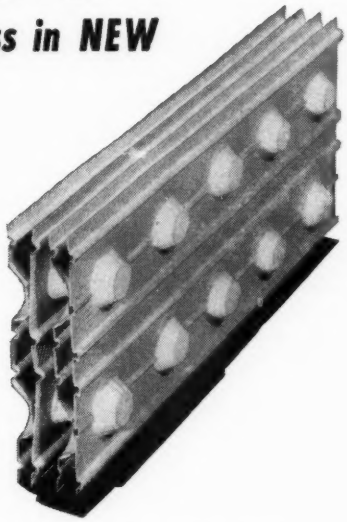
PACKAGED CHILLERS

PACKAGED HEAT PUMPS

EVAPORATIVE CONDENSERS and COOLING TOWERS

ROOM CONDITIONERS

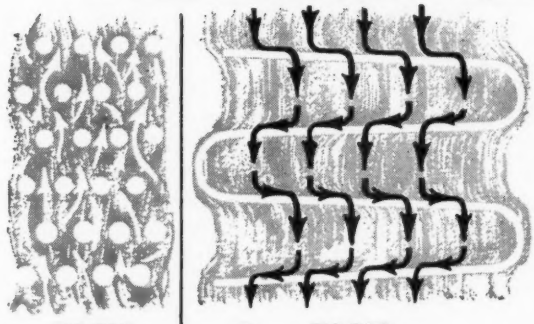
1 NEW Plastic Pak weighs 90% less in NEW FLOW-MIZER Cooling Towers!



The new all-plastic Acme-Pak offers further proof of Acme's progress in cooling tower design. Where a steel pak would weigh 2300 lbs. (as in the 100-ton tower), the Acme-Pak now weighs 180 lbs! This means less weight on roofs, easier installation, lower freight costs.

What's more, this remarkable new pak cannot rot like wood nor rust like metal. Water deposits cling less, are easily washed off. The new Acme-Pak cuts tower costs two ways: lower installed cost, lower maintenance cost.

2 Zig-Zag Coil Spacing means Greater Capacity, Less HP in NEW FLOW-MIZER Evaps.



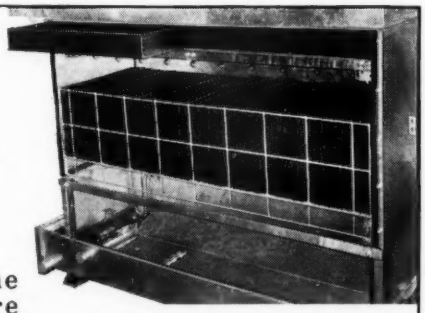
1 ZIG-ZAG CROSS-SECTIONAL SPACING

2 ZIG-ZAG LONGITUDINAL PITCH

Acme's zig-zag spacing improves coil efficiency in two ways. First by staggering the tubes cross-sectionally, both air and spray water are forced to travel a longer zig-zag path through the coil effecting greater turbulence and better heat transfer.

Secondly, Acme coils are pitched to form a continuous zig-zag slope longitudinally. This keeps the falling spray water in longer contact with the tubes, also allows the condensed refrigerant to drain more rapidly. The result is more efficient evaporation . . . which means greater capacity in less space with less blower horsepower required.

5 Full access to coils or pak

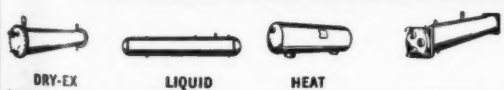


The new Acme Flow-Mizers are designed for full accessibility . . . fast, easy maintenance. In addition to sliding inspection doors, full-width panels are readily removed for convenient servicing of spray nozzles, eliminators, coil or pak. "File-drawer" pak and eliminators (see above) slide out for easy cleaning.

6 Balance where it counts

The complete blower assembly of an Acme cooling tower or evaporative condenser is electronically balanced *after* final assembly. Perfect balance is attained for quiet smooth-running operation under all conditions, less wear on blower shaft bearings, longer trouble-free service.

send coupon attached to your letterhead . . .



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- ☐ **New Flow-Mizer Cooling Towers,** 20 thru 175 tons
- ☐ **New Flow-Cold Cooling Towers,** 3 thru 20 tons

The Word *from* Washington

EDGAR A. POE
Consulting Engineer Correspondent

THERE is a strong belief in Washington's International circles that a concerted effort will be made to decrease Western Europe's dependence on the Suez Canal. Super tankers and other special overseas petroleum carriers are already being built, but most thought is being given to additional pipelines that would carry petroleum from Near Eastern wells to the Mediterranean without passing through unfriendly areas. There has even been some talk of another canal, but no one is taking this too seriously at present. Also, with the muddled situation in the Near East, it is hard to tell who is on which side. This year's friend might be next year's foe. Some kind of firm political program will have to be agreed upon before there can be any decision as to the best new means for petroleum transportation to by-pass the Suez.

FEDERAL aid for school construction is not dead, but it appears to be in such a weakened condition that the administration proposal has no chance of passage at this session. Despite White House pressure for federal aid, the program continues to lose strength. The economy wave, fear of federal control, and the segregation issue are to blame for the situation.

CONSULTING engineers who have foreign projects now getting under way or plan to have projects abroad in the future, should know about the services and information available to them from the embassies or consulates of foreign governments. Most of the embassies in Washington have special departments devoted to industry and commerce, and they can supply information on employment conditions, weather, housing, and other such matters that would be of considerable interest to any engineer undertaking a project in their country. The United States embassies and consulates abroad also can supply data and personal help. The International Cooperative Administration, with its main office in Washington, has a number of foreign offices and many good engineers on its staff. These men can supply technical information often not available from other sources. Consulting engineers would do well to make use of all these various sources of information before venturing into a foreign project.

FIRST training grants for air pollution research and technical assistance have been awarded through the Department of Health, Education, and Welfare. The program covers both the engineering and medical aspects of air pollution research.

FIGURES recently compiled by the U.S. Office of Education and the American Society for Engineering Education show that more students are preparing for engineering careers than at any time since 1948. These increasing numbers emphasize the problem of finding qualified teachers to meet predicted needs. There are now nearly 243,000 students in accredited engineering colleges, and the Office of Education will soon publish figures covering all the engineering schools, both accredited and non-accredited. Graduate studies in engineering also show a rapid gain in popularity with 22,240 masters degree students and 3400 students working toward doctor's degrees in engineering. Mechanical engineering had previously been the most popular, but it has been replaced by electrical. Nearly 20 percent of this year's undergraduates are planning on electrical engineering degrees with 17 percent aiming for mechanical. Civil, chemical, and aeronautical follow in that order. The full report on 1956-57 enrollments is published in the March issue of the *Journal of Engineering Education.*

THE greatest private and public construction program in history is underway. Economists predict that the 1957 U.S. construction total will come to $50 billion, topping the $45 billion spent in 1956. All the talk about tight money seems to have had little effect. While the Federal Reserve Board stands ready to ease credit if they feel such action is needed, there is evidence everywhere that the economy as a whole is healthy. Production, employment, and purchasing power are strong.

PENTAGON spokesmen report that an increasing number of industry officials, representing both large and small companies, are bringing consulting engineers to Washington with them to aid in negotiating for government contracts. The government is spending nearly $100 million every 24 hours in connection with the military security program in this country and abroad.

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INTERRUPTS 200,000 AMPS SYMMETRICAL

With a laboratory proven interrupting rating of 200,000 rms symmetrical amperes, General Electric's new line of Current Limiting Fuses now offer you better protection on circuits from 6 to 4000 amperes.

Your General Electric Apparatus Distributor will soon be able to offer you the advantages of local warehousing, fast delivery, and can now give you personal assistance in selecting the fuse to fit your needs.

	250 volts A-C or D-C	250 volts 60 cycle A-C	600 volts A-C or D-C	600 volts 60 cycle A-C	480 volts 60 cycle A-C
CURRENT RATING (Amperes)	6	300	6	300	1600
	15	400	15	400	2000
	20	500	20	500	2500
	30	600	30	600	3000
	40		40	800	4000
	60		60	1000	
	80		80	1200	
	100		100		
	150		150		
	200		200		

Progress Is Our Most Important Product

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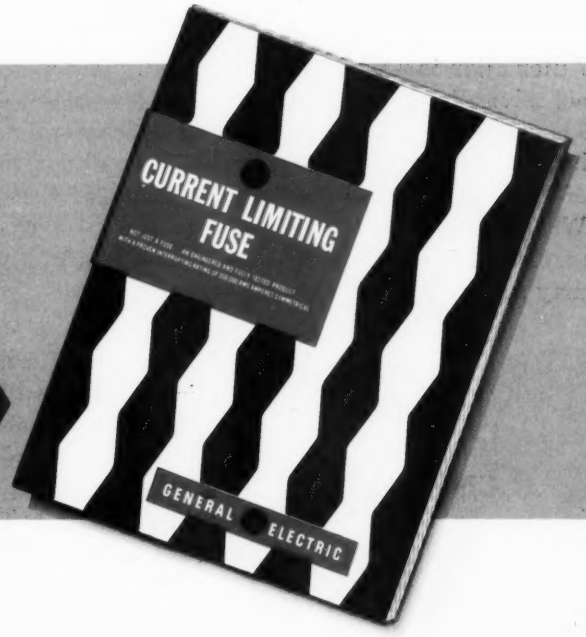
Although the 4000-amp giant of General Electric's CLF fuse line dwarfs its 6-amp "little brother," all ratings have the same laboratory tested current limiting characteristics. Ask your G-E distributor or General Electric sales engineer about them soon.

For complete descriptive information (GEA-6319B) on Type CLF fuses, write Section 528-1, General Electric Company, 1 River Road, Schenectady 5, N. Y., or ask your G-E distributor or General Electric representative for a copy of the CLF fuse bulletin.



The Reader's Guide

A Lean to the West

It would be wrong to call this a West Coast issue of CONSULTING ENGINEER, but there is something of a lean toward the West. The cover story features J. Donald Kroeker, consulting engineer, of Portland, Oregon, and first president of the Consulting Engineers Association of Oregon. In this issue we are also starting a department, "Report from the West Coast," which we hope to publish every month — or so long as the West Coast engineers continue to produce good copy. Then, there is an important feature article telling about a survey recently completed by a public relations firm engaged by the Consulting Engineers Association of Oregon. This project involved the sending of questionnaires to members of the Association, engineers in private practice who are not members, architects, contractors, government officials, and industrialists. We have divided the results of the survey into two parts. This month's article, "The Problems of Private Practice," starting on page 112, deals with the answers given by consulting engineers, architects, and contractors.

Fairer Fees

There is yet another article with a West Coast author, but it deals with a subject of nationwide interest — consulting fees. Ralph M. Westcott, now in his second term as president of the Consulting Engineers Association of California, has some new ideas about setting fees for engineering services. He argues that the percentage fee is basically backwards. It costs the engineer money when he manages, through ingenuity or hard work, to reduce the cost of a client's project. "A More Logical Fee Formula," on page 106, tells how, according to Westcott, the fee system should be changed.

An Editor in the East

Despite the strong flavor of the West in this issue, the East has not been neglected. Recognizing that there are more consulting engineers in that highly urbanized area between Boston and Philadelphia than anywhere else in the country, we have just assigned a full-time editor to that region. Marjorie Oden will take up residence in New York late this month. Miss Oden is a native of Texas and an excellent reporter with several years experience on metropolitan newspapers. It will be her job to call on consulting engineers in the East, find out what they are doing, and report to our readers through regular departments and feature articles. She will have her desk in our New York office, at 141 East 44th Street, and her title will be Eastern Field Editor.

Automated Warehouse

Automation is a wierd and wonderful development, but like Milltown, it will not solve all problems. As William H. Meserole points out in his article on page 96, automation may not be all it is cracked up to be when it comes to warehousing. Automation is applicable to repetitive production, but the movement of goods into warehouses and the filling of orders is anything but repetitive. When next you design a warehouse and the client wants it to function through an electronic brain rather than human brawn, Mr. Meserole's logical approach may supply you with strong arguments.

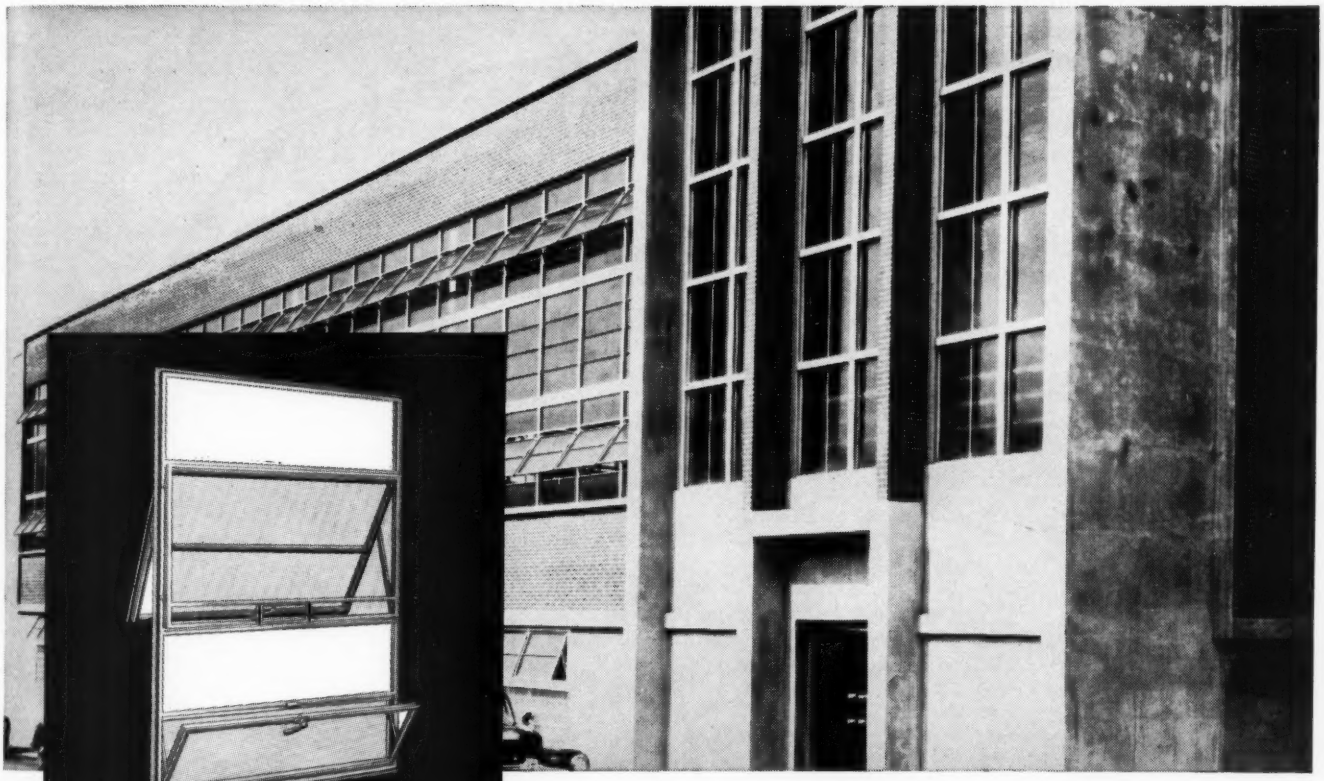
Close to the Glass Brick

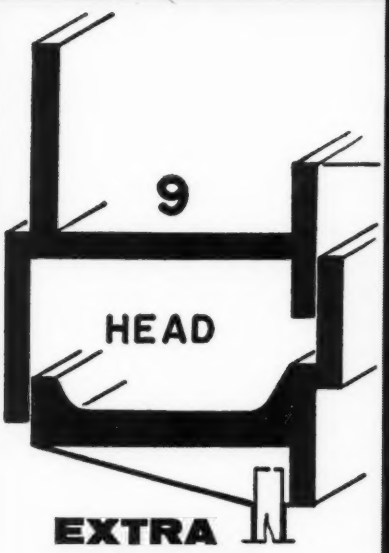
Our recent "Survey of the Profession" (Part III, Feb.) showed that about a third of the consulting engineers in this country are now building or are planning to build their own offices. Most of these are moving to the suburbs, but some still prefer downtown locations. Rust Engineering, in Birmingham, Ala., is one that would rather stay close to the glass brick. An article in this issue, "We Decided to Stay Downtown," by W. B. Speir, on page 93, gives Rust's reasons. They took an old building and turned it into a fine engineering office.

Modern Industrial Buildings Call for The Low Upkeep of

BAYLEY

ALUMINUM PROJECTED WINDOWS





EXTRA RUGGED

This full size detail illustrates the rugged, deep sections that give Bayley Windows extra durability. Note deep wall engagement and double weathering contact of ventilators.

Eliminates Painting

and reduces other window maintenance

Today's rising costs demand that every possible cent be saved on building maintenance. Paint elimination of aluminum construction is only one way Bayley Aluminum Projected Windows can cut these costs to the "bone". Their time-tested design offers—

- **Permanence coupled with modern appearance**
- **Simplicity of design—no complicated mechanism**
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Years of window specialization qualify Bayley Engineers—backed by most modern manufacturing facilities—to render you most complete window service. Centralize responsibilities by calling Bayley to follow-through, from the very start of your building plans.

THE WILLIAM BAYLEY CO.

Springfield, Ohio

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Reader's Guide — continued

Earthquake Experts

The recent earthquake in California makes the article "Earthquake Damage Can Be Controlled" on page 74, particularly timely. Admittedly, we had nothing to do with the earthquake, but it makes engineers more conscious than ever of the need for careful analysis of lateral stresses when designing buildings for earthquake areas. The authors of this article, Karl V. Steinbrugge and Vincent R. Bush, were not much impressed by the recent quake. They refer to it as a "newspaper earthquake" and go on to say, "Damage was minor and probably in total will be less than $1 million." You can't seem to work up much interest in a million dollars these days.

Soil Injection

An interesting project was recently undertaken in The Hague that involved extensive soil injection. The new post office consists of three buildings on which construction is starting at two year intervals. Before excavating the foundation of the first building, it was necessary to stabilize the soil under the two old buildings on adjacent sites. Later, these old buildings will be torn down and new ones erected in their place. The way in which this soil injection job is being handled is described in the article "Solving a Problem in Soil Stabilization" on page 80, written by two European experts, Ing. J. A. van Heerde, of The Hague, and Dr. H. Q. Golder, of London.

Water for Las Vegas

Las Vegas is willing to gamble — but not on their water supply. They had a more difficult problem than most cities in getting enough water to keep up with their expanding population. R. C. Kenmir & Philip Abrams, of James M. Montgomery, Consulting Engineer, of Pasadena, California, tell how the problem was solved in their article on page 82, "Designing a Supplemental Water Supply."

Permit Problems

The engineering problems involved in the use of nuclear reactors are formidable, but they seem simple when compared to the obstacles set up by Congress and the Atomic Energy Commission. In the last few issues of CONSULTING ENGINEER, Melvin Nord has been discussing the difficulties involved in working in the field of atomic energy. Mr. Nord continues his series in "The Legal Aspect" column this month. This column tells how to get a license to build a reactor. It seems easier to build a reactor than it is to get a license.

Practice in the Philippines

Vicente M. Decipeda, Chief Engineer, Industrial Development Center, Manila, is author of the "Report from Manila," on page 125. The Philippines are most conscious of their need for industrial development. They want to take their place as an economic power in the Far East. Currently, there are not many consulting engineers in the Philippines, (only ten firms in Manila), but they are doing important work, and they are seeking professional recognition. Some of their methods and many of their problems are similar to those of consulting engineers here in the United States.

Portrait in Black and White

We have experimented with several mediums and many styles of art for the cover portraits on CONSULTING ENGINEER. We have used pen and ink drawings, scratch board, various types of wash, and photographs. The portrait of Donald Kroeker on this month's cover is something new for us. It is a black and white oil painting, the work of a young Michigan artist, Marilyn Chenoweth. She is the wife of Richard Chenoweth, an engineer with Clark Equipment Company. Black and white oil paintings are none too common — we had never seen one and neither had Mrs. Chenoweth. Apparently that was no handicap, for she had the painting in our hands within a week after she was given the commission. Now that we have seen one, we like it. Mrs. Chenoweth is already at work on another portrait for next month's cover. Subject, Edward Wolff, consulting engineer of Chicago.

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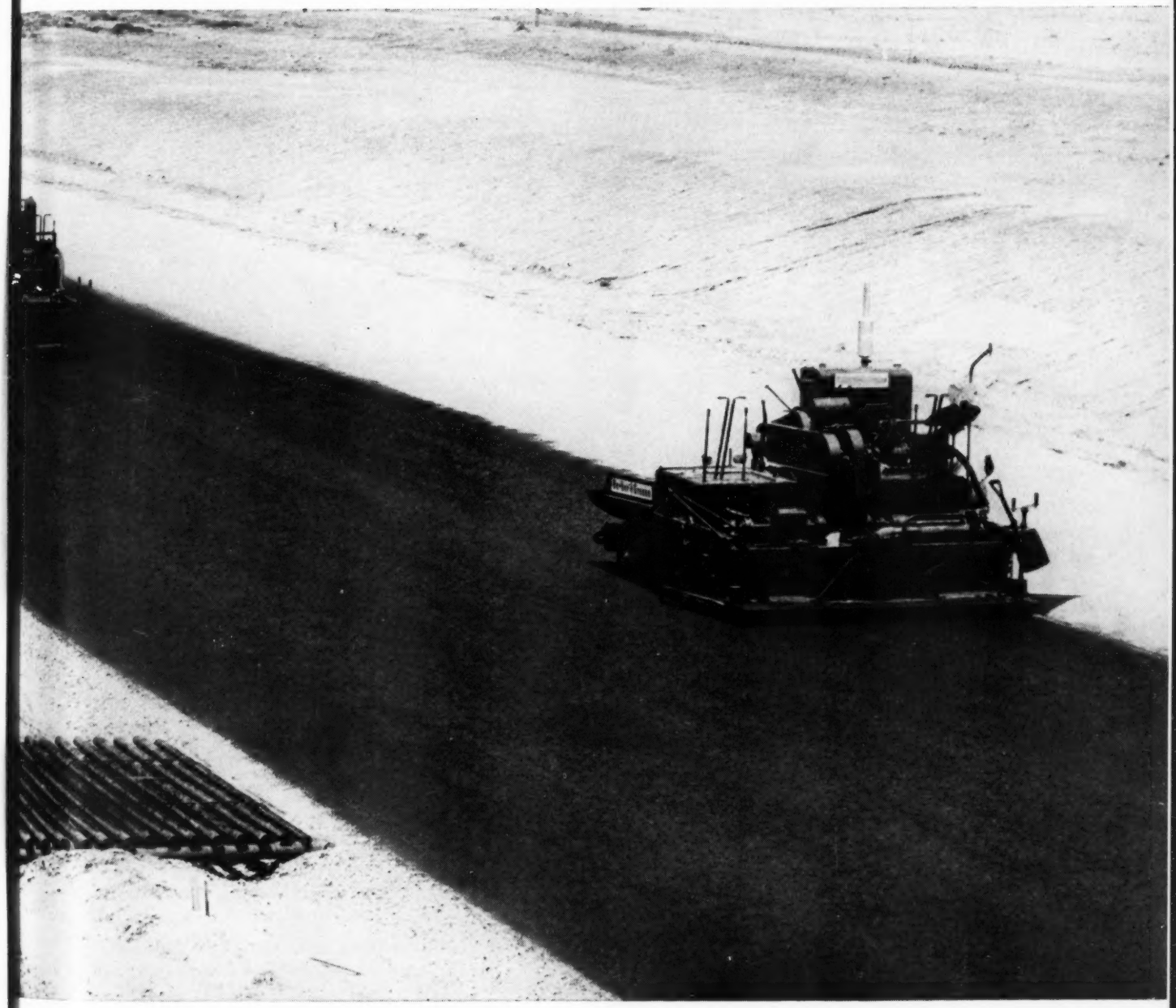

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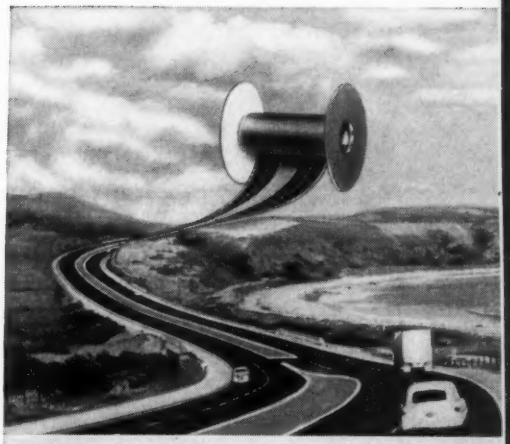

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MODERN **ASPHALT** HIGHWAYS

The Legal Aspect

MELVIN NORD, P.E.
Consultant in Legal and Technical Problems
Patent Attorney

Atomic Energy Law (Licenses and Permits)

In order to construct a reactor, it is necessary to obtain a license from the AEC. Sec. 101 of the Atomic Energy Act of 1954 provides that: "It shall be unlawful . . . for any person within the United States to transfer or receive in interstate commerce, manufacture, produce, transfer, acquire, possess, import, or export any utilization or production facility except under and in accordance with a license issued by the Commission pursuant to Sec. 103 or 104."

This is the basic licensing provision of the Atomic Energy Act, and it begins by making things unnecessarily complex by providing for two types of license. Additional licenses also are required every step of the way. Current criticism of the statute suggests that the entire licensing procedure should be radically simplified. However, at the moment we must take it as we find it.

Sec. 103 and 104 Licenses

Sec. 102 states the basic difference between the two major types of license: "Whenever the Commission has made a finding in writing that any type of utilization or production facility has been sufficiently developed to be of practical value for industrial or commercial purposes, the Commission may thereafter issue licenses for such type of facility pursuant to Sec. 103."

Since no type of reactor has been found by the AEC to have practical value for commercial purposes, Sec. 103 licenses (commercial licenses) as yet are unavailable. Therefore, at least at the start, our hypothetical atomic corporation will be applying for a Sec. 104 license (research and development license).

As provided in Sec. 104 (b): "The Commission is authorized to issue licenses . . . for utilization and production facilities involved in the conduct of research and development activities leading to the demonstration of the practical value of such facilities for industrial or commercial purposes," it will be necessary to convert the Sec. 104 license to a 103 license.

Construction Permits

Even before our Sec. 104 license is issued, we require a preliminary construction permit from the AEC in order to start construction.

The AEC has adopted a set of Rules, Part 50 (published in the Jan. 19, 1956, issue of the *Federal Register*) relating to the necessary licensing procedure. Rule 50.21 (b) authorizes the issuance of a Sec. 104 license for a "utilization facility involved in the conduct of research and development activities leading to the demonstration of the practical value of the facility for industrial or commercial purposes." Rule 50.23 provides that "A construction permit for the construction of a production or utilization facility will be issued prior to the issuance of a license if the application is otherwise acceptable; and will be converted upon due completion of the facility and Commission action into a license. . . "

The contents of the application for the construction permit are set forth primarily in Rules 50.33 and 50.34, and include the class of license applied for (i.e. Section 104), financial and technical qualifications of the company, earliest and latest dates for the completion of construction, and details of the process, facility, and site, sufficient for the AEC to determine radiation hazards. Rule 50.35 provides that if some of the latter information is not available when the construction permit is applied for, the reasons must be stated, as well as the approximate date when such data will be produced.

It is advisable to request the AEC, before a con-

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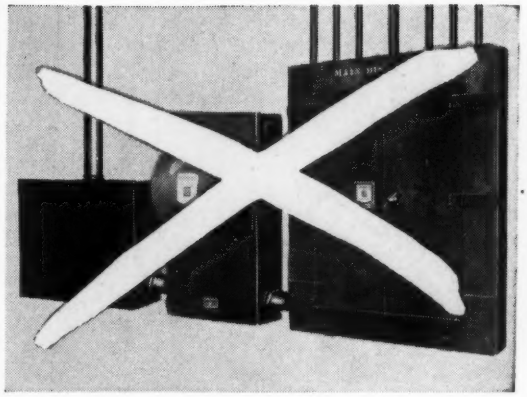

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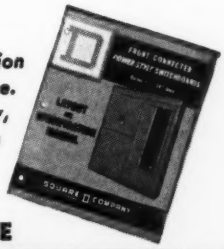

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struction permit is issued, to make a specific finding of fact that "it has information sufficient to provide reasonable assurance that a facility of the general type proposed can be constructed and operated at the proposed location without undue risk to the health and safety of the public and that the omitted information will be supplied" (Rule 50.35). While the rule expressly requires the AEC only to be "satisfied" of this, considerable trouble can be avoided by requesting them to make such an express finding. The construction permit will be made conditional, and the missing information must be supplied within the time specified (or such extension as the AEC may grant) so the permit eventually can be converted to a license.

The AEC may designate (or require the applicant to designate under Rule 50.36) those portions of the technical hazards information to be incorporated in the construction permit.

If construction is not completed on time, the applicant should request a renewal of the construction permit—under Rule 50.55—showing good cause why the work was not completed (developmental problems attributable to the experimental nature of the facility, fire, flood, explosion, strike, sabotage, domestic violence, enemy action, an act of the elements, and other acts beyond the control of the permit holder).

If desired, the application may include not only a request for a construction permit, but also for the ultimate licenses to be issued, according to Rule 50.52.

Construction Permit to License

When construction is complete, the AEC should be requested, under Rule 50.56, to convert the construction permit to a Sec. 104 facilities license, "subject to any necessary testing of the facility for health or safety purposes." The desired duration of the license should be specified. According to Rule 50.51, this can-

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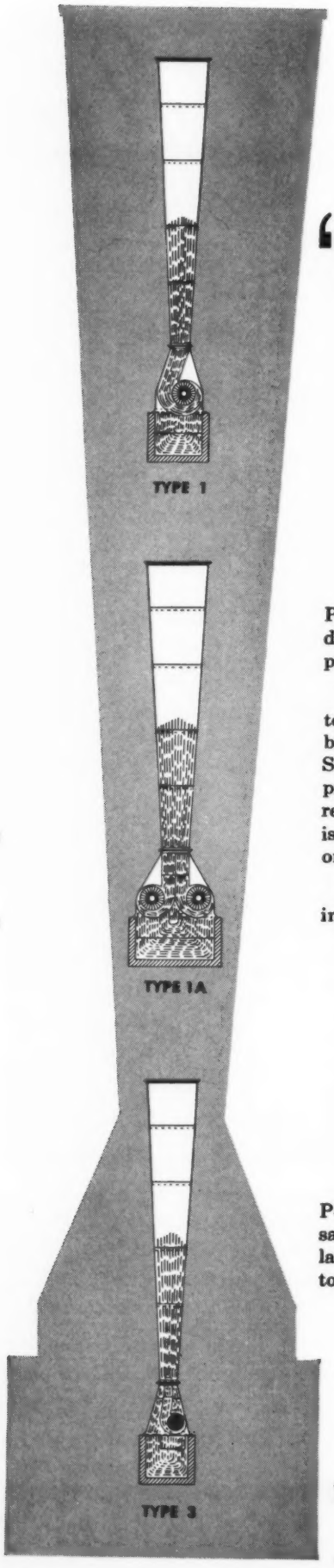

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Nuclear Material Allocation

In the original application for a construction permit (or else in the application to convert it to a license, but preferably the former), the AEC should be requested to include an allocation of an adequate amount of special nuclear material. The information that must be furnished the AEC for this purpose is specified in Rule 50.61. This allocation is only a bookkeeping entry in the AEC records, and does not involve actual distribution of special nuclear materials until they are needed. The allocation request should include a schedule of dates and amounts requested. This can be modified somewhat as circumstances require, under Rules 50.90 and 50.91.

In addition, an application must be filed with the AEC, under part 70 of the AEC Rules (printed in the Feb. 3, 1956, issue of the *Federal Register)* for a license to receive, possess, use, and transfer special nuclear material. If desired, this application may be filed along with other applications, but it may be desirable to have a separate license for this purpose, especially in connection with transfers of special nuclear material.

By-Product License

In the event a by-product license was not obtained earlier, it should be obtained now, as prescribed in Part 30 of the AEC Rules and Regulations (printed in the Jan. 11, 1956, issue of the *Federal Register).*

Operators' Licenses

As provided in Part 55 of the AEC Regulations (printed in the Jan. 4, 1956, issue of the *Federal Register),* an application must be filed for operators' licenses for each "individual who manipulates a control of a facility" (but not if only under the direction of a licensed operator). Each applica-

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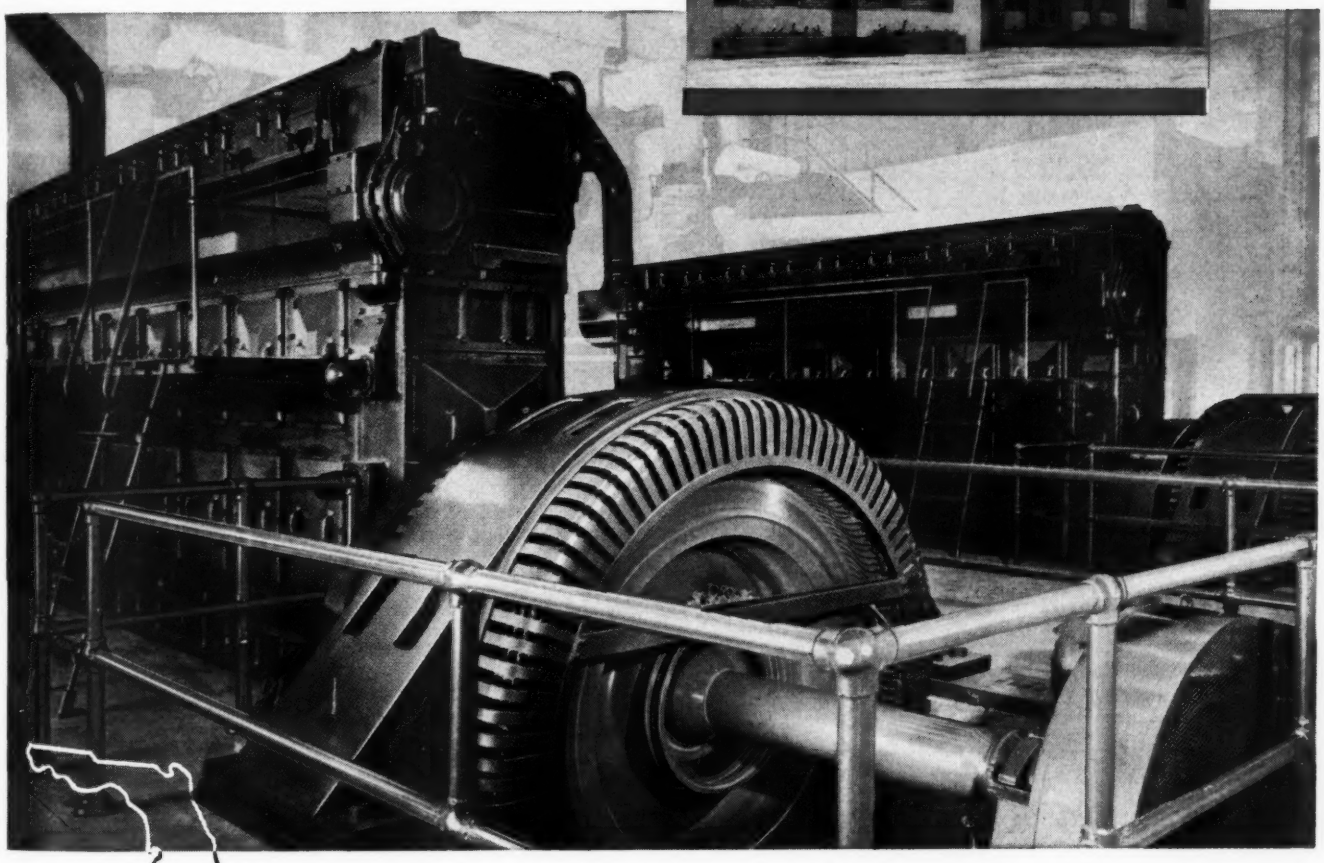

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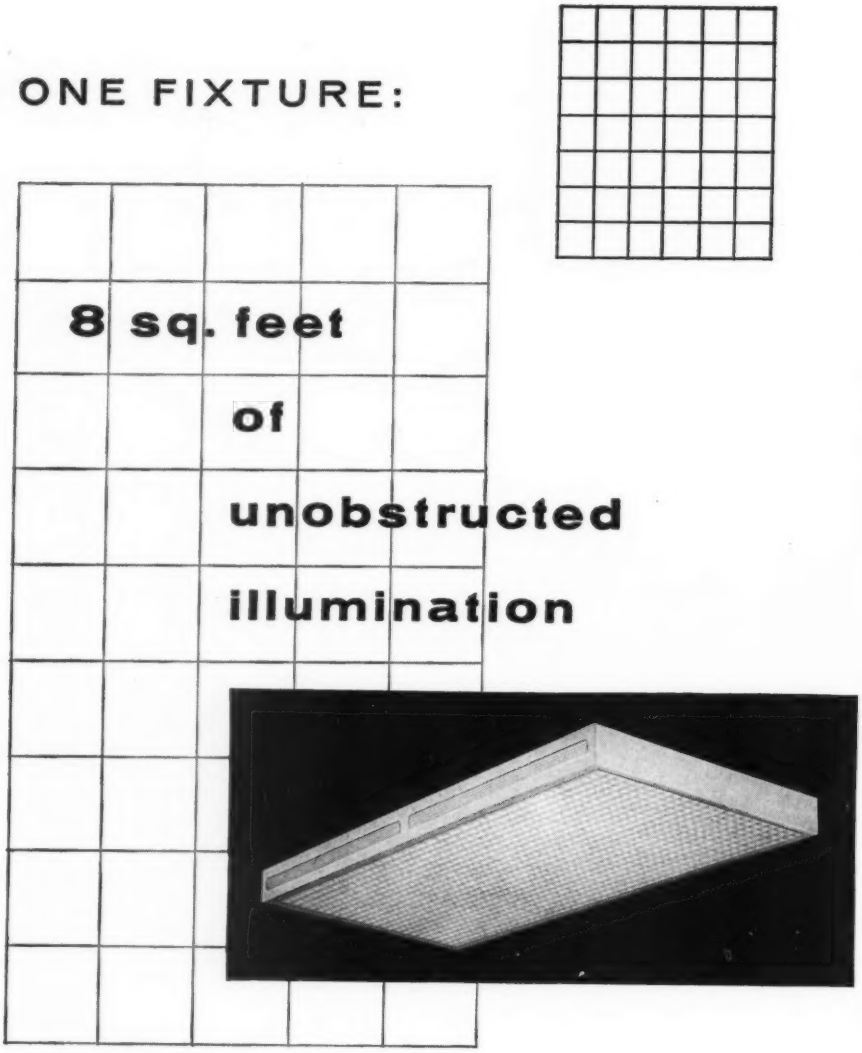

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tion must specify the exact controls to be operated, give evidence of the operators' qualifications, and include a report of his medical examination. Unless waived by the AEC, each operator must undergo an operating test and a written examination.

Conversion to Sec. 103 License

After commercial value of the plant has been demonstrated, the company then will wish to convert their Sec. 104 license to a Sec. 103 license in order to be sure that they can continue operating the plant beyond the developmental period. Furthermore, Sec. 103 licenses are necessary in order to export any reactors (Sec. 103a).

Before a license can be converted (under Sec. 102 of the 1954 Act), the AEC must make a "finding in writing that (the) type of utilization ... facility has been sufficiently developed to be of practical value."

The procedure for amending the license is prescribed in Rule 50.90, and requires "following as far as applicable the form prescribed for original applications" for Sec. 103 licenses. Some additional standards are prescribed in Rules 50.42 and 50.43 for Sec. 103 licenses for commercial power, e.g. "the proposed activities will serve a useful purpose proportionate to the quantities of special nuclear material ... to be utilized." These points should be considered in the application to amend the license, as well as the need for emphasizing desire to export production facilities.

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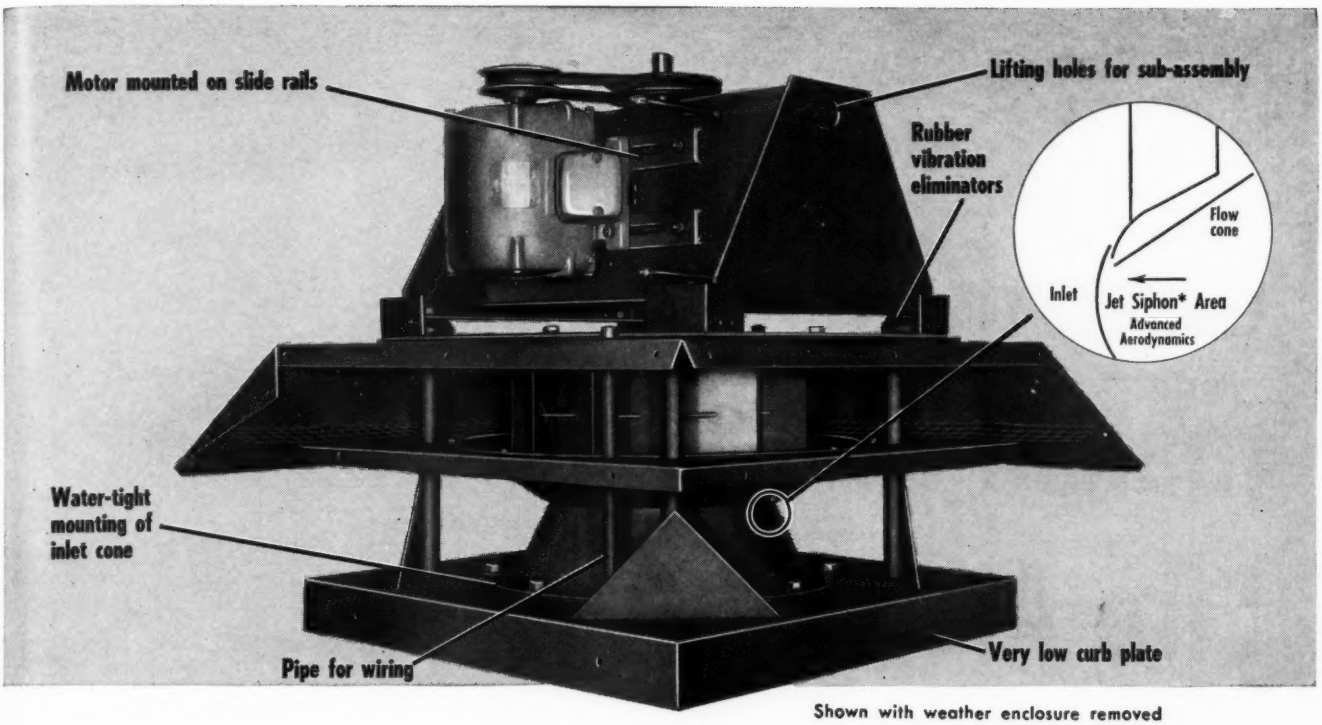

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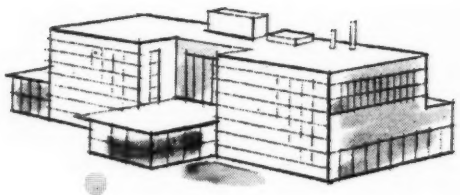

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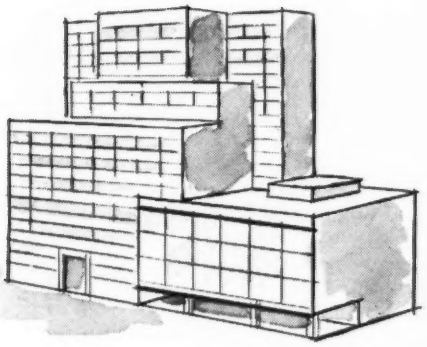

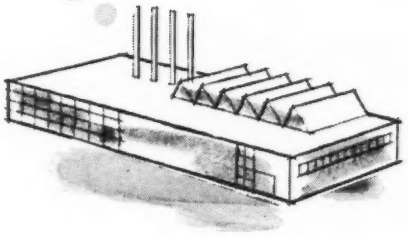

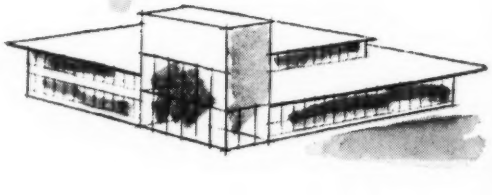

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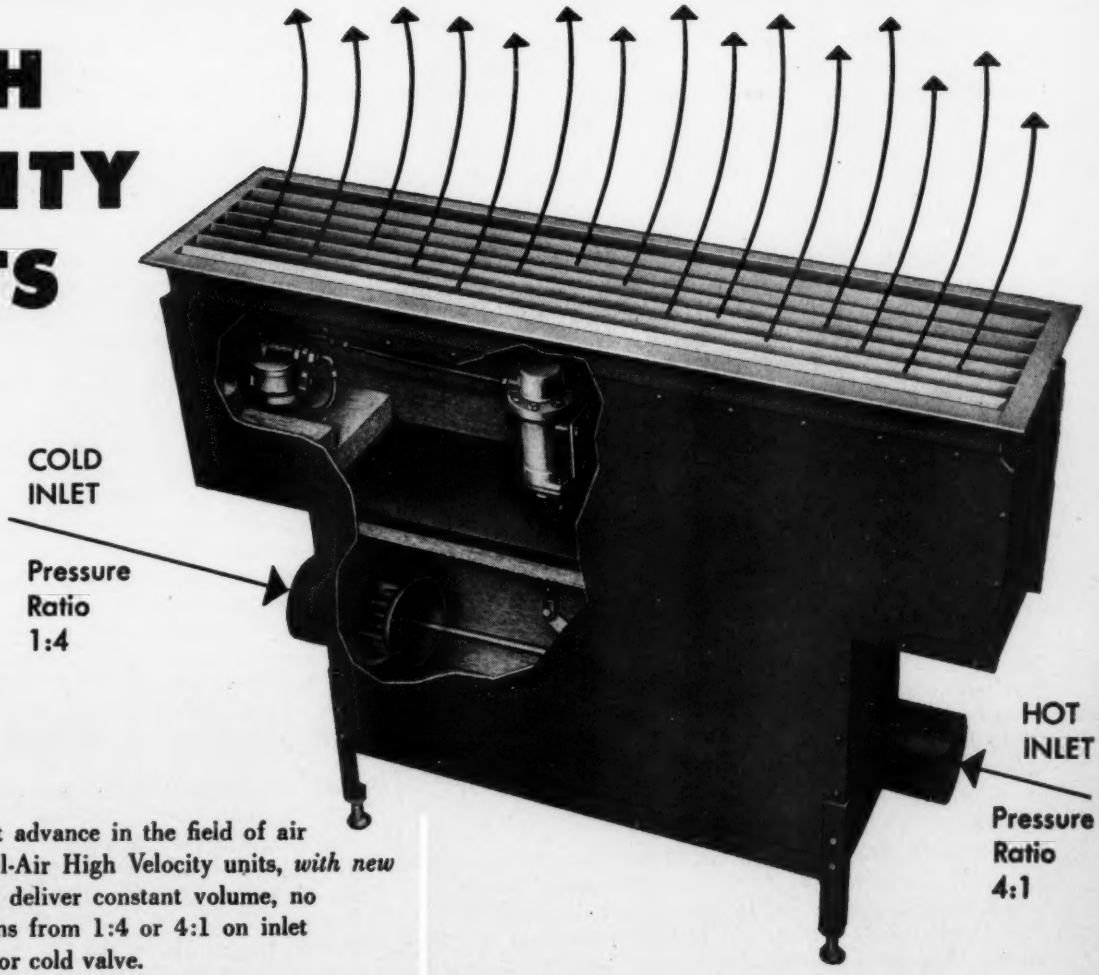

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STANDARD NUCLEAR INSTRUMENTATION within five years has been forecast by William J. Ladniak, Daystrom Nuclear Division. He predicts that standard reactor control instruments, chemical processing instruments associated with nuclear reactors, and health physics instruments will be the first to be available. In line with this, Leo Macklin, Combustion Engineering, Inc., in a speech before the Nuclear Congress in Philadelphia, listed standards and codes as prerequisites to significant expansion of the nuclear power equipment industry.

FLUOR CORPORATION'S expenditure in time and money on development of a new power reactor concept has been acknowledged by an AEC contract to develop and test special forms of uranium, thorium, and other new fuels suitable for a new type power reactor. Involved is use of flowing solid particles for nuclear fuel. Fluor believes that a reactor system using such a fuel type could be more economical, requires less fuel enrichment, operates at higher temperatures and lower reactor pressures, and involves less corrosion in the system.

TECHNICAL PAPERS presented at the Nuclear Congress will be available from the American Society of Mechanical Engineers for 30¢ each. A bound volume of Hot Laboratories papers are $10.00. Transcripts of the Atomic Energy in Industry Conference may be purchased from the National Industrial Conference Board, 460 Park Ave., New York.

DIRECTOR Kenneth Davis and Deputy Director Louis H. Roddis of AEC's Division of Reactor Development have said that AEC considers nuclear power plants that will go into service during the years 1957 to 1959 to belong to an experimental period during which there can be no hope of achieving costs competitive with modern conventionally fueled plants in the U.S., and that costs may range from 20 to 50 mills per kwh. They forecast that plants from 1960 to 1964 could produce power at 10 to 13 mills per kwh, and that those that go into service between 1965 and 1967 could achieve costs in the range of 9 to 11 mills. Further cost reductions by 1980 would then bring power cost down to 6 to 7 mills.

REPRESENTATIVES of the six Euratom nations, Italy, West Germany, Belgium, France, Luxembourg, and the Netherlands, have signed the Treaty Instituting the European Atomic Energy Community. Final step will be ratification by the governments of each country. Objective of Euratom is rapid acquisition of technical and industrial means for application of nuclear discoveries and particularly for large-scale production of atomic energy. Initially, the group probably will order plants similar to full scale units under construction in the U.S. and U.K., with the hope of having the first million nuclear kilowatts in service by the beginning of 1961.

SOME 17 MONTHS after his first press conference on the subject of controlled fusion, AEC Chairman Lewis Strauss on April 1 released the information that AEC has approved plans for the design and construction of a large experimental device for controlled fusion research at the Forrestal Research Center at Princeton University. Called the Model C Stellarator, the device consists essentially of a hollow tube containing ionized gas. Around the tube are external coils that produce a magnetic field to confine the gas. Objective is to heat the gas to temperatures of millions of degrees, while confining the heated gas within the tube for sufficient time to allow fusion reactions to take place. Earlier models of the Stellarator have been in use at Princeton but this will be the first of its size.

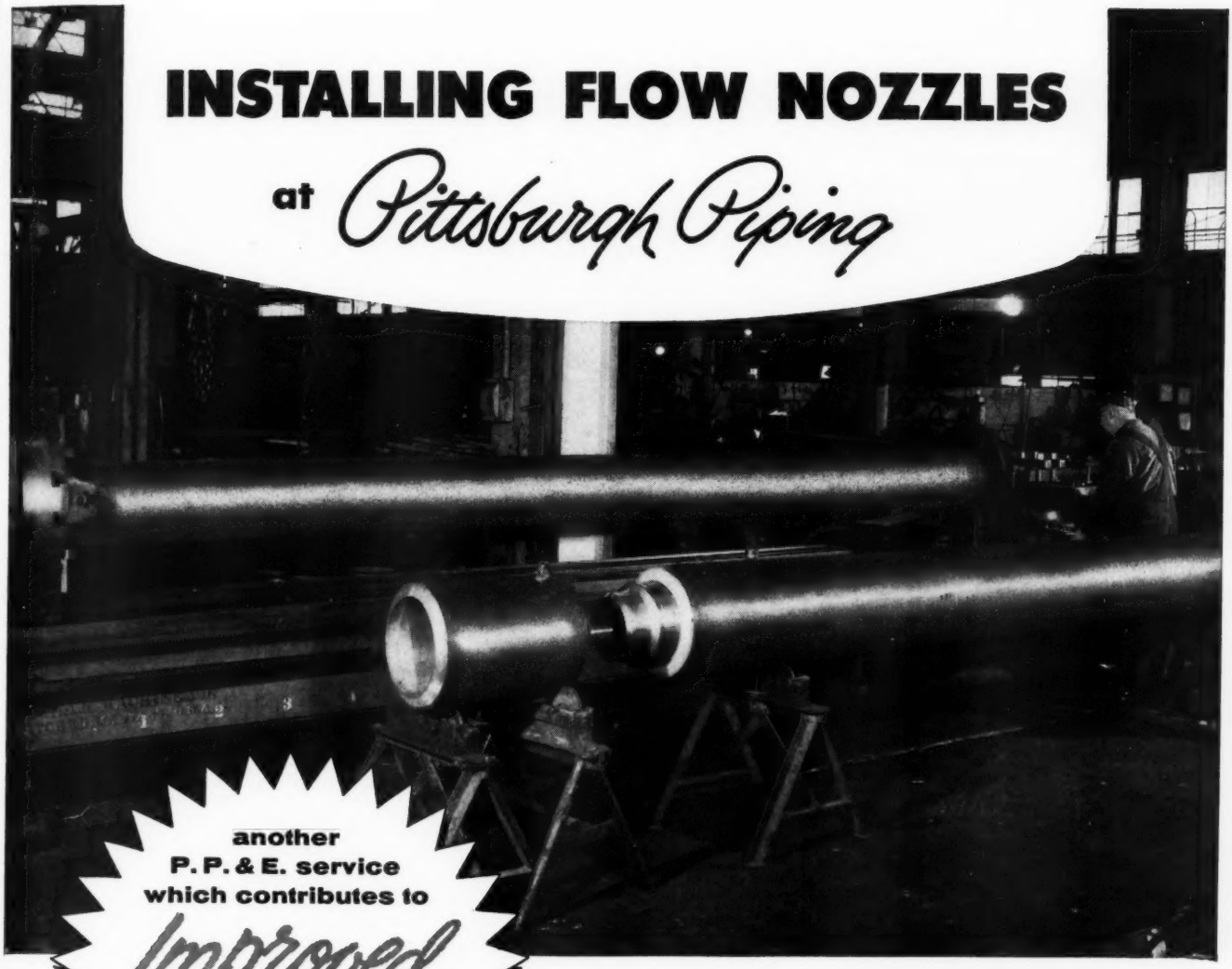
ANNUAL PREMIUM charges have been set for six reactor projects by the Nuclear Energy Liability Insurance Association. For $50 million worth of coverage Armour will pay $59,000; Battelle, $50,500; Commonwealth Edison (Dresden, Ill.), $250,000; Elk River, Minn., $69,430; General Electric (Vallecitos, Calif.), $67,000; and Yankee (Rowe, Mass.), $130,000. In the event that substantial losses do not emerge over a period of time, a retroactive reduction of premium charges will be made.

DIAGRAMS and photographs of various experimental and test reactors are given in AEC publication TID-4562, "Experimental Power and Test Reactors, A Technical and Pictorial Summary," Nov., 1956. Photocopies of the report are available from the Atomic Industrial Forum, Georgia Institute of Technology, the John Crerar Library, and Stanford Research Institute.

HAROLD J. BALHOUSE, of the Walworth Co., speaking before a meeting of the Atomic Industrial Forum, urged that a government indemnity policy for equipment suppliers be incorporated in any government legislation for indemnity to nuclear facility licensees and Atomic Energy Commission contractors.

INSTALLING FLOW NOZZLES

at *Pittsburgh Piping*



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P. P. & E. service
which contributes to

Improved

HIGH-TEMPERATURE HIGH-PRESSURE PIPING

Pittsburgh Piping's precision installation of flow nozzles in high-pressure piping is the result of extremely skillful machining, fitting, and welding by experienced craftsmen. This is another example of advanced techniques — available at Pittsburgh Piping — which provide greater safety, higher efficiency and longer life from high-pressure, high-temperature piping.

Precision fitted flow nozzles; largest shown is for 16" main steam line; 4" and 6" sizes in foreground are for boiler feed lines.

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Carbon Steel Piping	Forged Piping Materials
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PP-19

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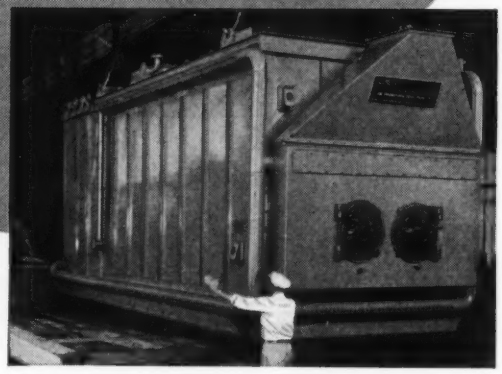

One of (2) 40,000,000 Btu./Hr. packaged HTW Generators being loaded for shipment to Johnson & Johnson, New Brunswick, N.J.

...Over 20 Installations to date,

including industrial, government, institutional and air terminal projects. Here is proof of the unequalled acceptance of International-LaMont Forced Recirculation Generators for the most efficient, lowest cost high temperature water for large area heating, power and process requirements—with these exclusive advantages:

- **NO THERMAL SHOCK** — System return water is circulated through the Built-In Economizer and brought close to saturated temperature by flue gases BEFORE reaching the radiant furnace zone.
- **BUILT-IN ECONOMIZER** permits safe use of maximum available temperature differential between boiler outlet and system return water. Temperature differentials from 175°F. to 200°F. are possible and recommended. Result: lower original equipment and operating costs.
- **LOW HEADROOM BOILER.** Minimum height reduces cost of boiler house construction . . . permits installation in many existing structures.
- **COMPLETE RANGE OF SIZES** from 2 to 200 million Btu per hour or larger . . . design pressures to 500 psi with corresponding temperatures. Pressurized furnace or induced draft operation. Individual boiler circulating pumps or combined pump system if preferred.

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A THREE PHASE program will be initiated at the National Reactor Testing Station, Arco, Idaho, to improve facilities for handling radioactive wastes. The first phase involves construction of one uncooled and two cooled 300,000-gal stainless steel underground storage tanks, with necessary piping and control house. The second phase, covering preliminary design engineering on 1,200,000 gallons of stainless steel tankage with piping and control house, is aimed at developing an improved type of facility for storing liquid waste. The third phase will be construction of a waste calcination facility, including a waste treatment building, two concrete storage vaults for solid plant wastes, and waste handling equipment. Fluor Corp., Ltd., is handling design engineering.

AEC DEMONSTRATED its belief that Power Reactor Development Co. would be able to go ahead with its Lagoona Beach power reactor installation by signing a contract to provide up to $4,450,000 in assistance consisting of research and development work in Commission facilities; consultant and information services; and assistance in training reactor plant operators and maintenance personnel. Waiver of the normal fuel use charge for a period beginning with the contract date and ending five years after issuance of the AEC license to operate the facility will be worth another $5 million to PRDC.

THE WEST GERMAN utility firm, Rheinisch-Westfalisches Elektrizitatswerk A.G., has ordered a 15,000-kw boiling water reactor power plant from AMF Atomics, Inc. and the U.K.'s Mitchell Engineering Ltd. It will be similar to the reactor that AMF is to build for the Rural Electric Cooperative Association, of Elk River, Minnesota.

COMBUSTION ENGINEERING, Inc. has built or holds contracts to build reactor pressure vessels for a good portion of the naval nuclear-powered ships and prototypes: the Seawolf and its land-based prototype; the Submarine Advanced Reactor; the Large Ship Reactor; the Submarine Reactor Small (which Combustion is building in its entirety); the Triton; the first nuclear powered aircraft carrier; and the first nuclear powered frigate. This is in addition to pressurizers, steam generators, and cores for submarine reactors.

THE ENGINEERING TEST Reactor under construction in Idaho for AEC is scheduled to go critical in

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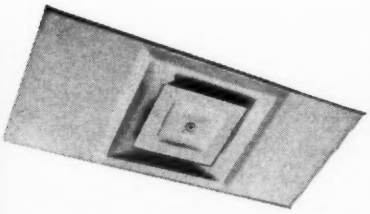
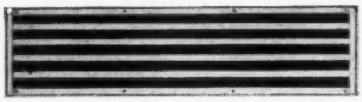
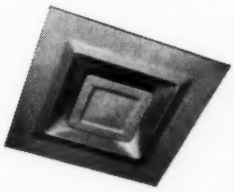
For residential, commercial or industrial installations . . . wherever effective, controlled air diffusion is needed . . . there is a Kno-Draft Air Diffuser to do the job better. Fully adjustable for both air volume and direction, Kno-Draft Air Diffusers are engineered to perform dependably for more working and living comfort, designed to complement any architectural motif. Kno-Draft Air Diffusers are produced exclusively by Connor Engineering Corporation.



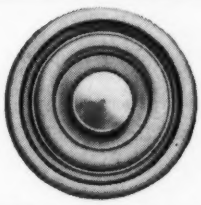
Panel type, for suspended acoustical ceilings. Two styles, three sizes to deliver from 75 to 175 CFM. Sleeve-type damper for instant volume control. One-piece pressed steel furnished in baked-on flat white enamel to match acoustical ceiling panels. Write for Bulletin K-36.



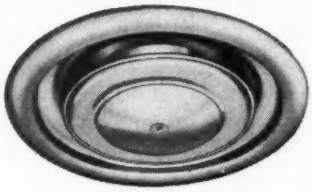
Slotted type KLS, for modern interiors. Effective diffusion assured by adjustable vanes, easy volume control by grid-type damper. Classic lines will enhance any decor. Available in 2-, 3-, 4-, 5- or 6-foot lengths for single or continuous installation. Write for Bulletin K-27.



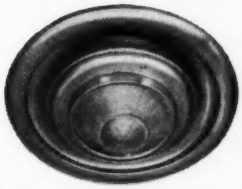
Square types KP and KPT, for flush ceiling mounting. In two smart designs: Type KP, overlap design for plaster ceilings; Type KPT, to snap into T-bar grid of acoustical tile ceilings. Both engineered to assure complete, dependable diffusion. Write for Bulletin K-27.



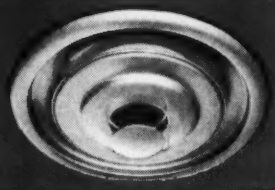
Type SRD, combination supply-return. For use where air is supplied and exhausted through one unit. Supply air cannot "short circuit" into return air opening. Built-in dampers provide independent supply and return air volume control. Of spun aluminum. Write for Bulletin K-20A.



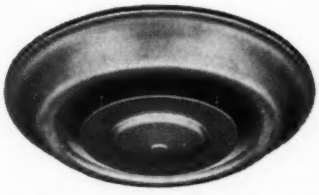
Type KDA for all-purpose use. The diffuser specified most by architects and engineers. Adjustable for air volume and diffusion pattern after installation. Spun aluminum construction. In all sizes for flush ceiling or exposed duct mounting. Write for Bulletin K-20A.



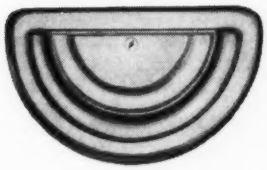
Type KDA with built-in light fixture. Combines attractive lighting and controlled air diffusion. Solves many installation problems. In design and application, this functional diffuser has all the features of the standard type KDA shown at left. Write for Bulletin K-20A.



Type SPKR, combination speaker-air diffuser. For P.A. or piped music systems. Provides same central location for both sound and air diffusion. Accommodates any extended range 8" speaker. Specifications are same as those of standard Kno-Draft types described in Bulletin K-20A.



Type KH, for residential use. Pre-engineered for both heating and cooling applications. Easily installed, may be used with either round or rectangular ductwork. An exclusive integral anti-smudge cone eliminates unsightly ceiling smudge. Provides quiet, draftless air diffusion. Type KH-L, at right above, incorporates a smart lighting fixture that may be used with either a 75- or 100-watt lamp. Illumination and air diffusion are thus combined in a single unit. Both KH and KH-L units are made of spun steel, with aluminum lacquer finish. Write for Bulletin KH-76A.



Type KDA, for butting against walls or columns. Half-round design for use where standard diffusers would not be suitable. Features include Kno-Draft precision air pattern adjustment and sleeve-type damper (optional). Spun aluminum construction. Write for Bulletin K-31.

CLIP THIS PAGE— CONNOR **KEEP IT AS A HANDY REFERENCE GUIDE**

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adjustable air diffusers

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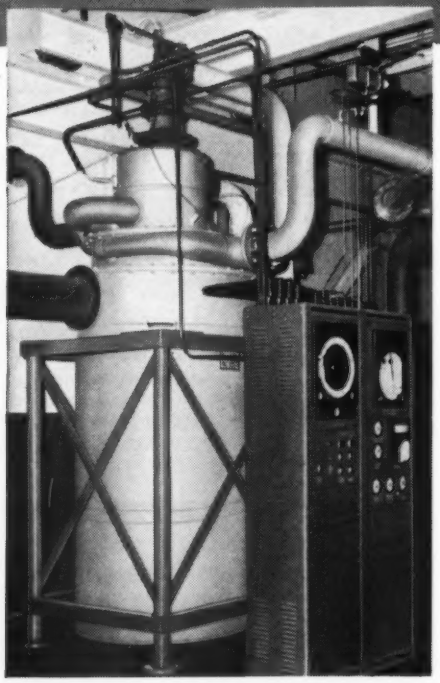
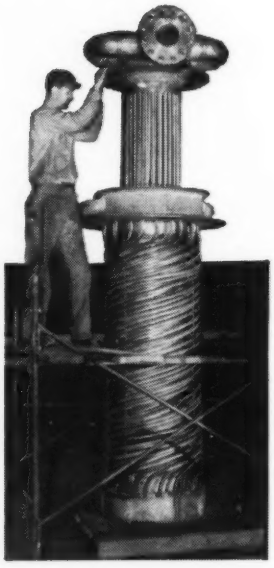
DANBURY, CONNECTICUT

THERMAL FIRED HEAT EXCHANGERS



a compact means of heating air or process gases for testing or production



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Whether it be an existing standard design or a unit for special requirements, THERMAL heat exchangers provide the ultimate in compactness, high performance and response. These heat exchangers are always designed around the high velocity, clear flame combustion characteristics of THERMAL burners. Convection is thus the primary means of heat transfer thereby promoting uniform metal temperature and longlife. THERMAL Heat Exchangers are supplied as complete package installations including all control and accessory equipment.

DESIGNS AVAILABLE FOR:

Pressures from 0 to 1500 PSIG. Temperatures from 300°F to 1500°F. Heat transfer ratings from 250,000 BTU/hr to 35,000,000 BTU/hr.

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REPRESENTATIVES IN PRINCIPAL CITIES

May, 17 months after start of construction. Kaiser Engineers have given the final cost at $17,200,000. Extended construction time was blamed partly on production delays of components, an average of one and a half months after they were scheduled for delivery.

THE INCREASE in plant capacity announced by Consolidated Edison for its Indian Point, N. Y., reactor power station will be 23,000 kw from the reactor and 16,000 kw from the superheater. This raises the total capacity from 236,000 to 275,000 kw.

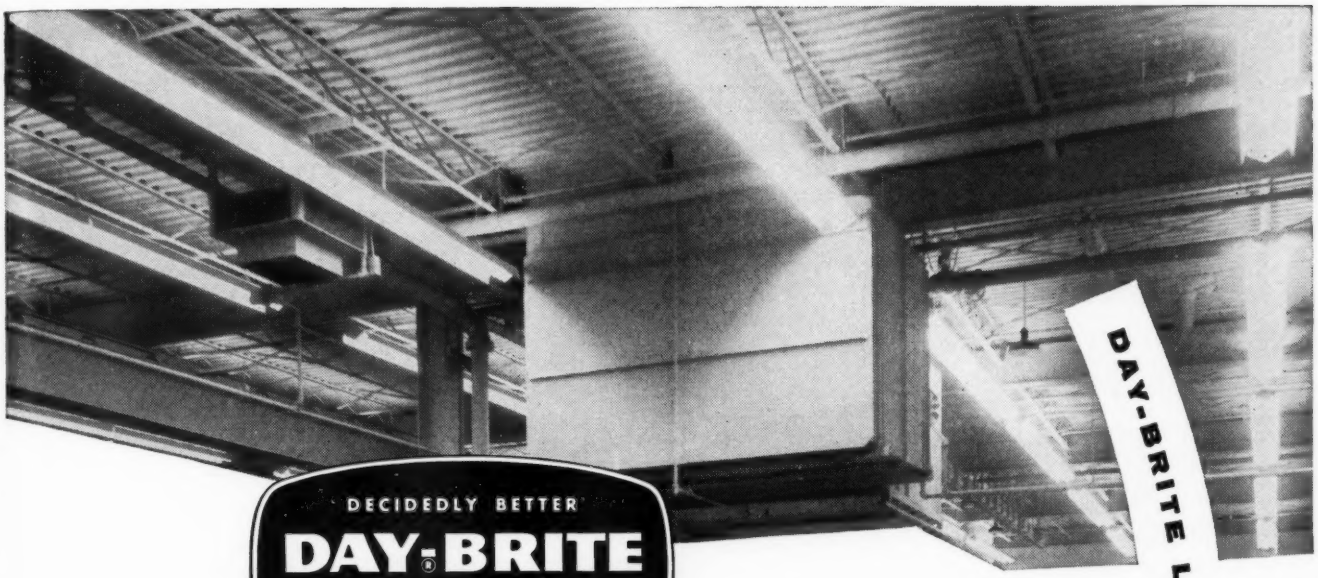
BASIC THORIUM and uranium metals, alloys or oxides, for fuel element fabricators will be produced at the new materials plant to be built by W. R. Grace & Co. at Erwin, Tenn.

MOLYBDENUM and niobium are expected to take a prominent position in high temperature (2000 to 4000 F) reactor applications, according to Bernard Kopelman, of Sylvania Electric. He explained that their strength to weight ratio is exceptionally high, making them better bets than metals such as tungsten, although these metals also are undergoing re-examination for high temperature operation. Rare earth metals also hold promise. Kopelman was not so optimistic about the immediate development of ceramics because of their brittle nature.

ISOTOPE-ACTIVATED PHOSPHOR markers have been tested successfully in the field for use on airport landing strips, on buoys, as street markers, for various types of signal lights, as exit markers, on instrument panels, and in similar types of service.

PILOT PLANT runs at Argonne National Laboratory have demonstrated the feasibility of decontamination of irradiated uranium by a process based on volatility of uranium hexafluoride. Following dissolution of uranium metal in liquid bromine trifluoride, uranium hexafluoride was decontaminated to an activity level well below that of natural, unirradiated uranium. A fission product decontamination factor of the order of 10^8 was obtained by distillation. Volatility processing methods also are applicable to enriched fuels by means of fused salt dissolution.

RADIOACTIVE WASTE disposal facilities at the Shippingport plant will have to handle per month 23,000 gallons of reactor plant effluent, 7,660 gallons of high-solids liquid wastes, 36 cu ft of reactor plant spent solid



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DAY-BRITE LIGHTING MAKES THE BIG DIFFERENCE HERE

Lower costs with new high-output CFI

Equipped with new high-output, rapid-start lamps, the new Day-Brite CFI (Comfort For Industry) fixtures provide a high level of over-all illumination at lower over-all cost.

The new CFI fixtures are designed with slotted openings in the reflector tops which direct a portion of the light to the ceiling and permit natural updraft ventilation. Maintenance is reduced because reflectors and lamps stay cleaner longer—resulting in extra light at no extra cost. Also, eyestrain and fatigue are minimized because harsh ceiling contrasts are washed out.

For the newest idea in industrial lighting, consult your Day-Brite representative. He's listed in the Yellow Pages. Send for new CFI literature. *Day-Brite Lighting, Inc., 5479 Bulwer Ave., St. Louis 7, Mo.*

NATION'S LARGEST MANUFACTURER
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Transformer test and repair shop, Rochester Gas & Electric Corp., Rochester, N. Y., equipped with new Day-Brite CFI-25 fixtures

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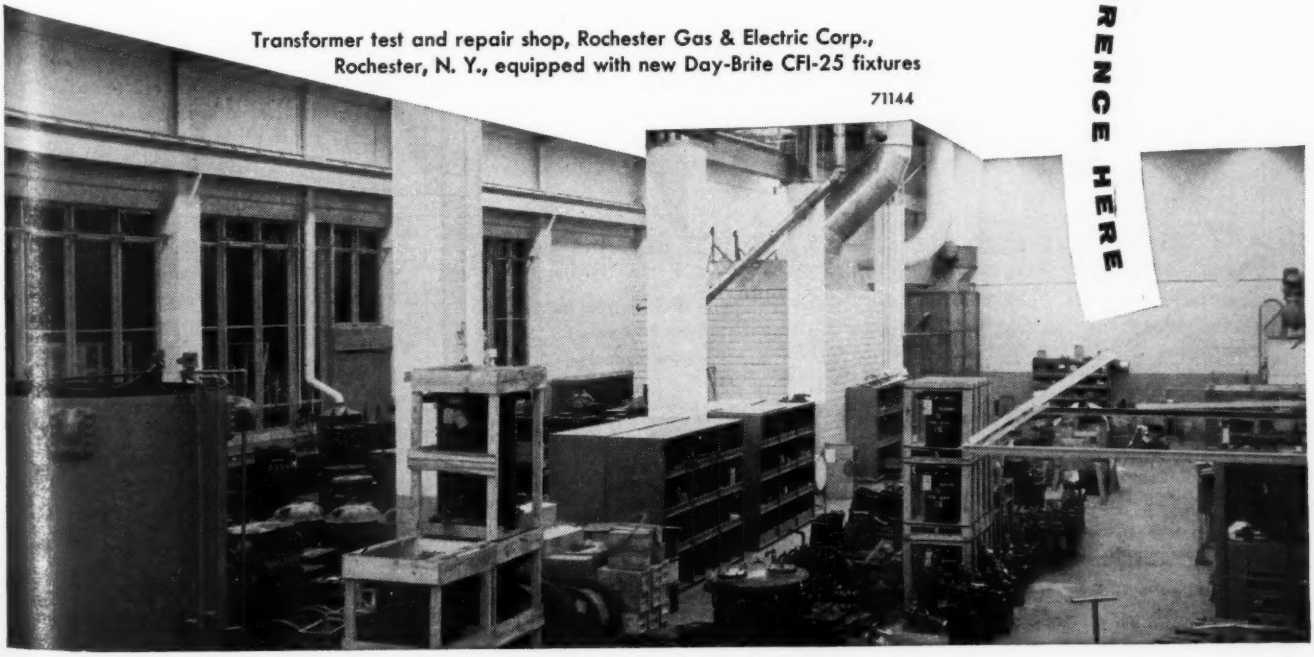
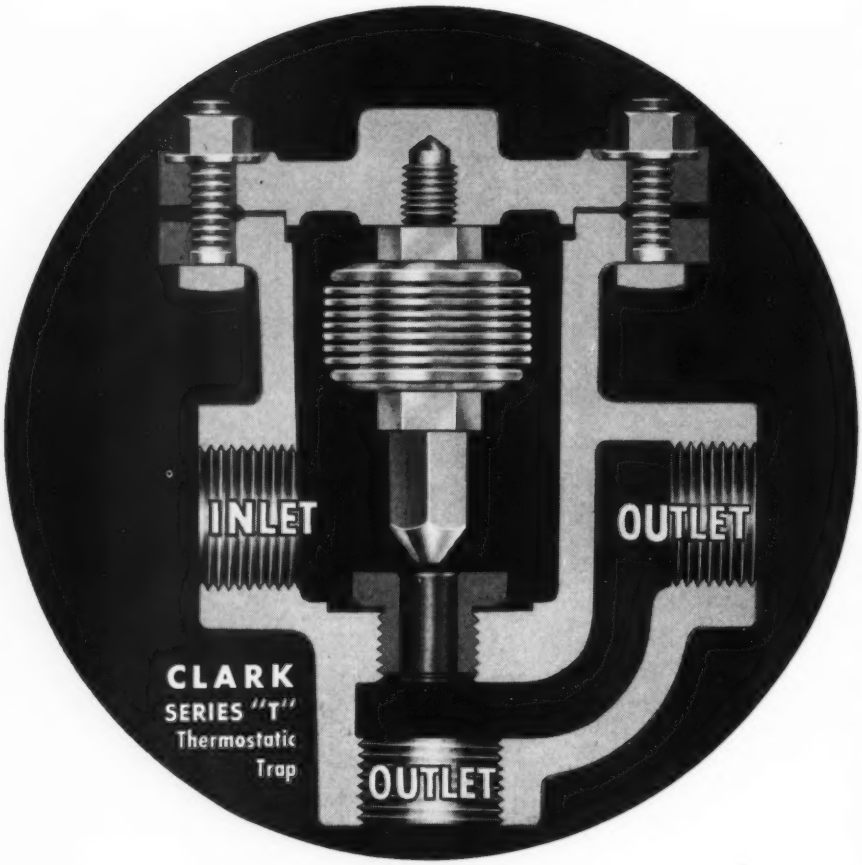


Clark

FITS TO A "T"



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resin, 2000 to 4000 lbs of combustible solid wastes, and a variety of non-combustible solid wastes.

R. L. DOAN, Phillips Petroleum Co., told the Nuclear Congress that the recovery of one pound of uranium, containing 30 lbs of aluminum, from spent fuel elements from the Materials Testing Reactor, requires 420 lbs of nitric acid, 125 lbs of aluminum nitrate, 700 lbs of hexone, 900 lbs of demineralized water, and 10 lbs of 28 percent ammonium hydroxide, in addition to 70,000 lbs of steam and 200,000 gallons of cooling water.

GENERAL MOTORS isotope laboratory is developing a rapid technique for measuring tool wear on a large production type lathe. Radioactive tungsten-187 is used as a tracer material. One microgram of tool material in the chips can be measured with this method, amounting to the material worn off the tool during one second of operation.

ON THE ASSUMPTION that 18 civilian reactors will be in operation by 1962, the daily reprocessing load will be about 0.4 metric ton of uranium, as estimated by Oak Ridge National Laboratory. A preliminary study suggests that Indianapolis, Ind., would represent the optimum location for the first fuel recovery plant.

GENERAL ELECTRIC engineers have demonstrated that increasing the acidity of reactor cooling water reduces substantially the corrosion rate of aluminum alloys. In one test run, introduction of phosphoric acid reduced the corrosion rate to about one-seventh of that encountered with high purity water.

PROCESS CHANGES at Savannah River aimed at reducing waste that must be stored have been successful to the extent that the volume per ton of uranium processed is now about 40 percent of what it was during initial operation. If evaporation studies underway work out, volume of wastes to be stored should be reduced by a factor of three over the present rate, to one-eighth original volume.

CZECHOSLAVAKIA has announced intention to begin construction of a 150,000-kw nuclear power plant this year and to complete other plants after 1960. East Germany also plans a construction start this year of a 150,000-kw plant.

TENTATIVE target date for the first General Conference of the International Atomic Energy Agency is

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CERTIFIED POWER

FOR CAT* DIESEL ENGINES

CATERPILLAR TRACTOR CO.

ENGINE POWER CERTIFICATION

This is to certify that the Diesel Engine herein described has been engineered, manufactured and tested in accordance with rigid Caterpillar Standards. The materials and workmanship incorporated into this engine give it the inherent capacity for satisfactory performance when applied in accordance with the power ratings established and recommended by this company. The MAXIMUM OUTPUT capacity of this standard production engine is 200 H.P. @ 2000 R.P.M. equipped with: air cleaner, water pump, lubricating oil pump, fuel pump, and standard intake and exhaust manifolds.

I certify that R. L. Henson, Supervisor of Diesel Engine Test, Caterpillar Tractor Co., ... 11/30/58

R. L. Henson
Supervisor Diesel Engine Test
Caterpillar Tractor Co.
Peoria, Illinois

Caterpillar Model D326 Industrial was manufactured and shipped as follows: Engine Serial No. 39B1018 Shipping Date February 11, 1957

Power Setting 152 H.P. @ 1600 R.P.M. Intermittent Power Rating

Radiator & Fan	Tachometer Drive
Ether Starting Aid	Muffler
32V Charging Generator	Heater Connections
Governor Control	Remote Shut-off

POWER RATINGS

MAXIMUM OUTPUT is the horsepower capacity of the engine, a measure of the maximum power, ± 5%, that can be developed for five minutes without drop in speed.

INTERMITTENT HORSEPOWER is a rating for use in variable load applications such as excavators, hoists, and standby power units, where the duration of sustained full power output is one hour or less, with the average output not over 80% of Intermittent Horsepower.

RATED HORSEPOWER is a rating for use in applications such as planing mills, hammer mills, and rock crushers where the duration of sustained full power output is 12 hours or less.

CONTINUOUS HORSEPOWER is a rating for use in applications such as work boats and pumps where the duration of sustained full power output is 24 hours per day, day in—day out.

Horsepower figures are established in accordance with rigid Caterpillar standards. All ratings, corrected to sea level barometric pressure (29.92 in. Hg.) and standard temperature (60°F), apply to a production engine including air cleaner, water pump, lubricating oil pump, fuel pump and standard intake and exhaust manifolds. The above ratings are based on British and American BHP.

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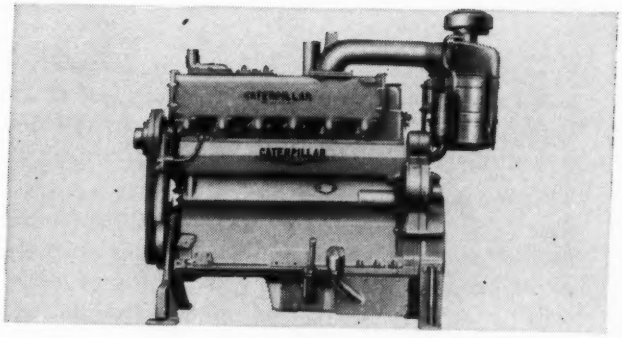
In a quarter century of diesel leadership Caterpillar Engines have achieved a reputation for *honestly rated power*. Owners have found that they can depend on a Cat Diesel to deliver the power promised.

Now, to back this reputation, Caterpillar becomes the *first* manufacturer to issue a certificate showing the horsepower capabilities of the engine. This certificate is signed by Caterpillar Tractor Co. and certified by a notary public.

You have a right to demand *certified power* when you invest in an engine. You get it when you buy from your Caterpillar Dealer. Let him show you the certified power plant that fits your needs.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.



CATERPILLAR*

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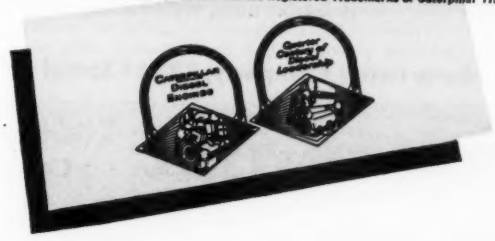
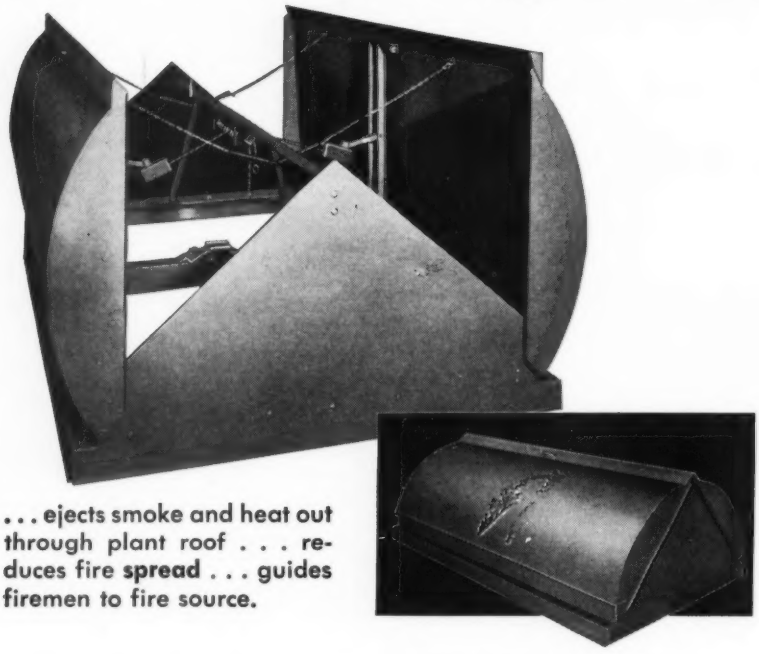


Keep your fire loss Down

with the efficient new

Swartwout Pyrojector



. . . ejects smoke and heat out through plant roof . . . reduces fire **spread** . . . guides firemen to fire source.

Pyrojector is an effective answer to fires that billow up and spread under closed roofs. It opens a 28 square foot draft-fed escape vent for smoke and flames. Heat at 212° F. melts a fusible link — releases powerful spring force that opens dampers instantly.

This is a completely new design, with unusual features. Low contour (only 29" above curb), neat appearance. Installs and operates *entirely above roof level.* Spot it over most likely fire sources, singly or in groups. Or alternate with roof ventilators. Weatherproof when closed. Can be opened for extra ventilation in dry weather. Dampers are double wall construction, insulated. Release mechanism is rugged, positive.

For complete details of this new "escape" ventilation unit, write today for Form 701-P.

The Swartwout Company, 18511 Euclid Ave., Cleveland 12, Ohio

Swartwout ROOF VENTILATORS AND VENTILATING LOUVERS

ALSO AUTRONIC PROCESS CONTROL EQUIPMENT

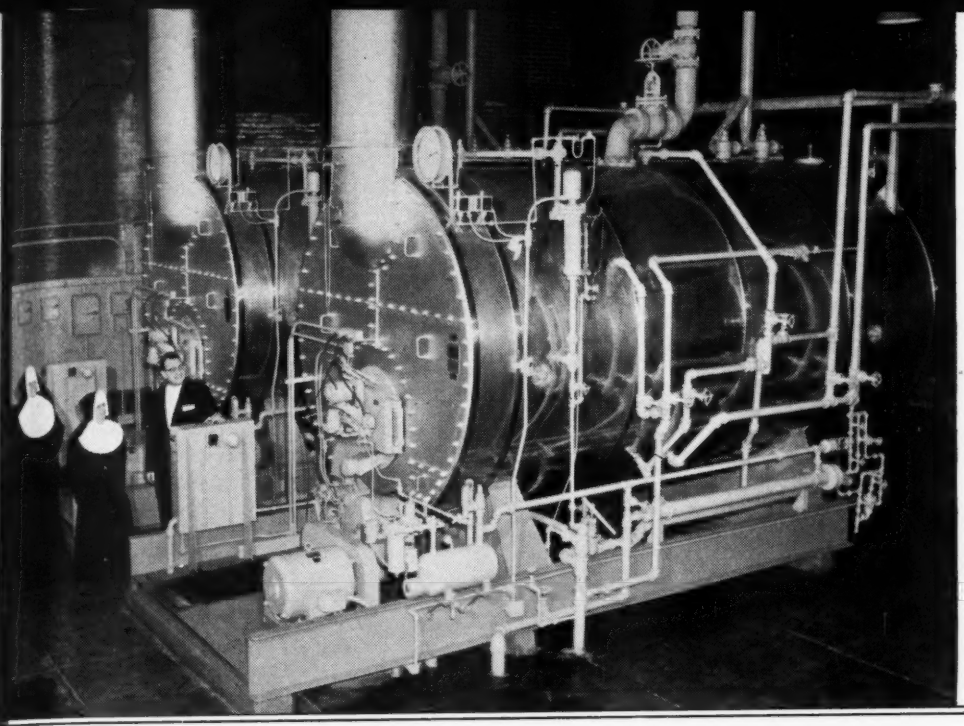
August 19th, at Vienna, Austria. President Eisenhower sent the statute to the Senate on March 21 with a strong recommendation for early approval. As of the end of March, Egypt, Guatemala, Switzerland, and the U.S.S.R. had ratified the statute.

NORWAY'S 20,000-thermal-kw boiling heavy water reactor at Halden will cost about $700,000 to build, plus about $2.5 million for the uranium fuel and heavy water moderator. It is scheduled to be completed later this year. The completed reactor will supply power for pulp processing.

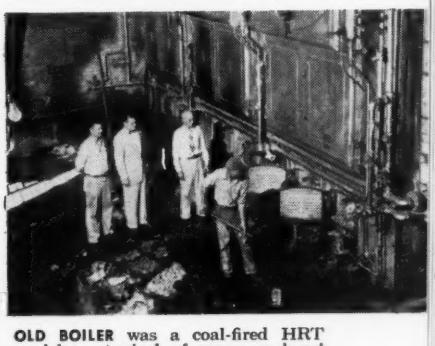
THE PRESSURIZED water reactor to be purchased by Belgium from Westinghouse will be installed at the Mol reactor center instead of at the 1958 Brussels International Exposition, as originally planned. Besides this 11,500-kw PWR, the Mol center will have a medical reactor, a gamma ray source, and a high flux materials testing reactor, the BR-2, with a power level of 25,000-thermal-kw. Belgian industry has plans to put into operation, between 1962 and 1967, four power stations with a total capacity of 500 to 600 mw, and to produce in 1967 about 15 percent of the power needs of the country. The first three of these reactors will be of the convertor type, but it is hoped that the fourth will be a fast breeder.

REAR ADMIRAL H. G. Rickover blasted the atomic industries indirectly in his explanation of the excessive cost and time expended on the four operating plants of the Naval Reactors Program—the Nautilus, Seawolf, and their land-based prototypes. He said that components have proved less reliable than the reactors themselves, delivery time slow, and costs high. In remarking that many ". . . companies dissipate efforts of their technical manpower on academic reactor feasibility studies, but give little, if any, consideration to the overall reliability of the plant," he grouped the problems into two parts. They were "lack of fundamental understanding even of common materials and of their fabrication," and "lack of management attention to the work, both from an organizational and from a detailed technical standpoint."

BRITAIN has upped its target of 1.5-2 million kilowatts of nuclear power capacity announced in its 1955 White Paper Plan to 5-6 million kilowatts to be in operation by the end of 1965. The tripled program is to be achieved from only 19 stations, seven more than the 12 originally planned. They probably will be of the Calder



NEW BOILERS combine efficiency and handsome appearance. Edward S. Green, Edgemont (Pa.), contractor, was responsible for this superior installation. Pictured left to right are: Sister M. Cor Immaculatum, Immaculata College Treasurer, Sister Jean Marie, Community Treasurer, Reverend Mother Maria Alma, Superior General and Salvatore S. Guzzardi, Consulting Engineer.



OLD BOILER was a coal-fired HRT model — typical of many replaced by modern Cleaver-Brooks oil, gas or combination oil/gas fired boilers.

Consulting engineer* tells how Immaculata College boiler modernization saves estimated $12,000 each year

Salvatore S. Guzzardi CONSULTING ENGINEER

2928 LEWIS TOWER · PHILADELPHIA 2, PA · KINGSLEY 6-2777

December 20, 1956

Mr. John C. Cleaver, President
Cleaver-Brooks Company

Dear Mr. Cleaver:

Recently our office was retained to make an impartial, exhaustive engineering study of the 40-year old boiler plant and steam system at Immaculata College, Immaculata, Pa., which is staffed by the Catholic order, Sisters of the Immaculate Heart of Mary.

As a result of our recommendations, two fully automatic, oil-fired, 350 bhp Cleaver-Brooks package steam boilers, (12,000 lbs/hr steam each), replaced three hand-fired coal boilers and steam-driven auxiliaries. The new boilers are operating at approximately 80% boiler efficiency year-round.

Conversion of coal firing to automatic #6 oil firing and increased boiler efficiency has reduced the fuel cost approximately 50% -- amounting to a saving of $12,000 each year.

The Cleaver-Brooks boilers burn #6 oil and operate automatically at 80 pounds steam pressure 'round the clock -- without the presence of operators in the boiler room. Eliminating boiler plant labor saves the College $7,500 each year.

The cost of the boiler plant modernization will be paid for out of fuel and labor savings in approximately 2-1/2 years.

Commendation for this outstanding performance of the Immaculata boiler plant is due to your well-engineered boiler design and to the cooperation of your skilled servicemen. The results achieved were so impressive that the Sisters subsequently modernized their Villa Maria Convent, Westchester, Pa., with two 100-bhp Cleaver-Brooks boilers.

Sincerely yours,

Salvatore S Guzzardi

*Salvatore S. Guzzardi — Award-winning head of an organization of experienced professional engineers specializing in modernizing power service facilities. Clients include: Pennsylvania University, Baldwin-Lima-Hamilton Corp., H. Daroff & Sons, Sun Shipbuilding & Dry Dock Co. and City of Philadelphia.

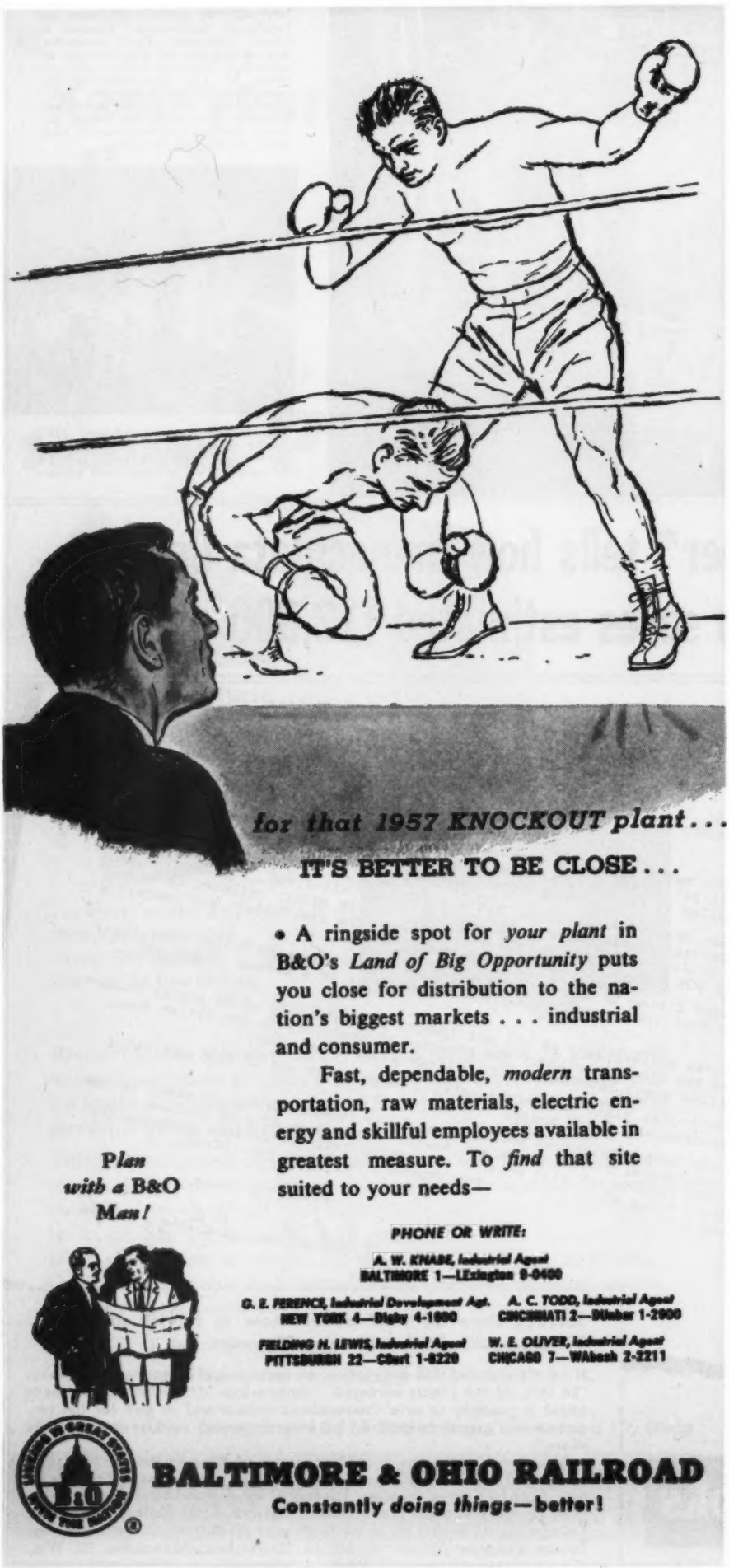
Surveys show 32% of boilers now in service are 30 years old; 56% are over 20 years old

If your boiler fits this description, we recommend an immediate survey. "In 90% of the plants surveyed," summarizes Mr. Guzzardi, "we have found it possible to save thousands of dollars and to pay for the recommended improvements out of annual savings within one to three years."

Again and again the proved economy of Cleaver-Brooks four-pass, forced-draft boiler design results in savings reports as impressive as this. Contact your nearest Cleaver-Brooks representative for more facts on the complete line of steam and hot water boilers — 19 sizes, 130 models, 15 to 600 hp — for heating or processing. Or write Cleaver-Brooks Company, Dept. F, 321 E. Keefe Ave., Milwaukee 12, Wis., U.S.A. Cable Address: CLEBRO — Milwaukee — all codes

Cleaver Brooks

ORIGINATORS OF SELF-CONTAINED BOILERS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Hall type with improvements and modifications. Sir Christopher Hinton, of the U.K. Atomic Energy Authority's Industrial Group, expects that by 1970 nuclear power will be appreciably cheaper than conventional power. At the present time, Britain has in operation or under construction four twin reactor atomic power stations financed by the Atomic Energy Authority for the dual purpose of power and plutonium production; one experimental fast breeder power plant being built by the AEA; and three power plants being financed by the Electricity Authorities of England and southern Scotland.

AEC has notified access permit holders that visits to operations and area offices made for the purpose of obtaining advice or assistance in solving problems specific to the holders' activities henceforth will be considered to be consultations subject to standard fees. Charges may amount to as much as $175 per day, depending upon the salary and the amount of time spent by each consultant who works on the problem. Minimum charge is one-half of the appropriate daily rate.

ENGINEERS from Atomic Power Development Associates, United Engineers and Constructors, and Vitro Corporation of America told the EJC meeting in Philadelphia that they estimate a pyrometallurgical reprocessing plant capable of handling irradiated fuel from a 500-mw fast breeder (18,000 kg per year) would cost $3,277,000 to build and $1,427,000 per year to operate. The same engineers estimated that a fabrication plant for remotely fabricating the radioactive fuel materials recovered from the pyrometallurgical reprocessing plant would cost $1,708,600 to build and $1,247,800 per year for operating expenses.

IN ITS REPORT on the possibility and consequences of accidents in nuclear power plants, AEC referred to six "runaway" incidents, either inadvertent or planned, experienced to date on research or experimental test reactors. There was one each at Chalk River, Borax, and at the Experimental Boiling Reactor — An inadvertent super-criticality at Los Alamos in 1949 during manual testing of two new control rods; at Argonne in 1952, manual withdrawal of a control rod produced a super-criticality; and in 1955, a leak in the stainless steel core of the North Carolina State College water boiler research reactor allowed fuel solution to leak into the surrounding chamber and the cooling water.

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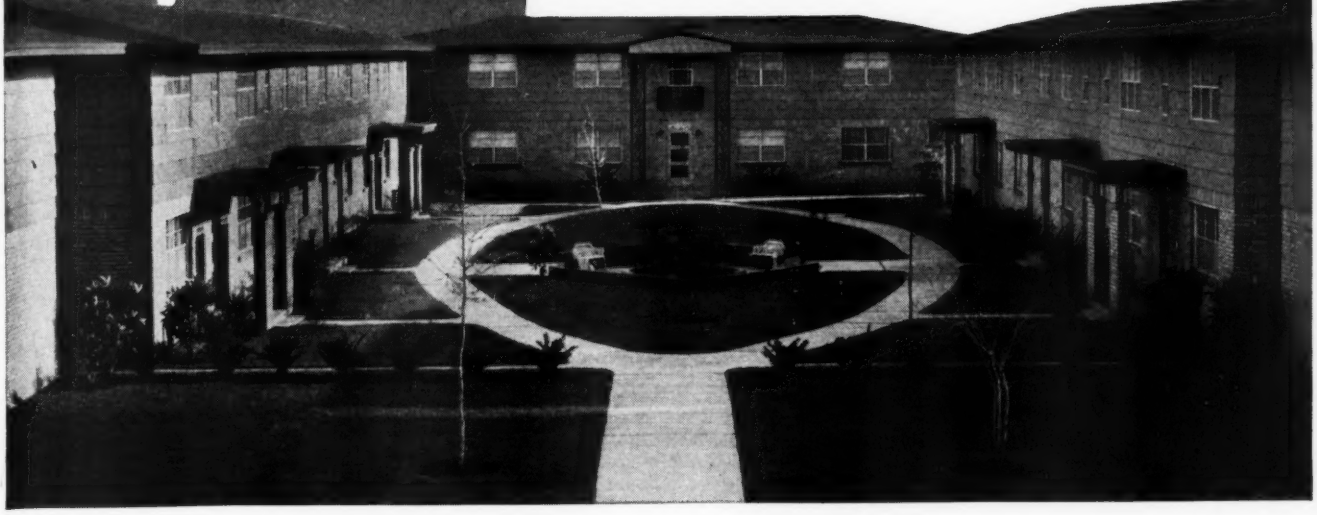
AIRTEMP keeps the 354 units of Houston's La Fonda development cool, even in Texas' hottest weather. Equipment: three packaged chilled-water systems which total 390 tons capacity. *Consulting Engineer:* O. E. Winter. *Builder:* Winter-Mallette Building Company. *Architect:* Joseph D. Reynolds.



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Argonne National Laboratory Experimental Boiling

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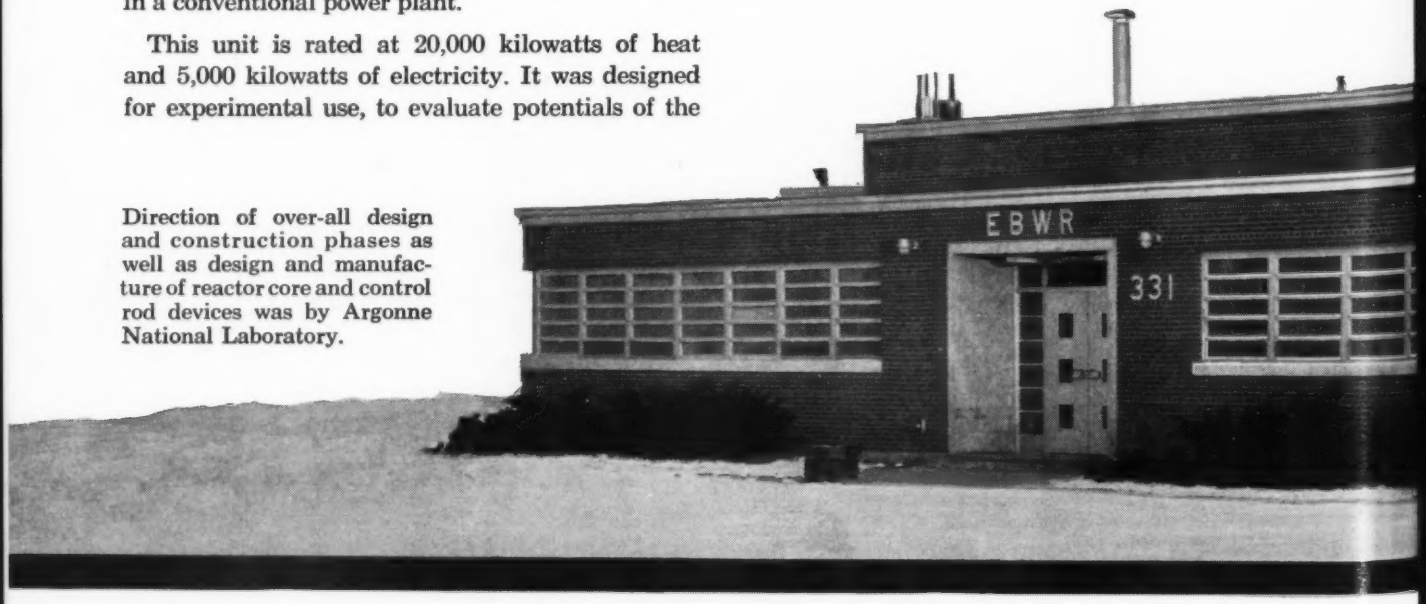
NOW in operation at Lemont, Illinois, this is the first commercial-type power plant in the United States to generate usable quantities of electric power from nuclear fuels.

The unique feature of this boiling water reactor is that live steam is actually generated in the uranium core by nuclear heat and piped directly to the turbine without need for intermediate heat exchangers as required by other types of reactors. In effect, it operates very much like the coal-fired boiler in a conventional power plant.

This unit is rated at 20,000 kilowatts of heat and 5,000 kilowatts of electricity. It was designed for experimental use, to evaluate potentials of the boiling water reactor for large-scale commercial applications. Power generated is used by the Laboratory to meet a portion of its own electric power requirements.

Allis-Chalmers is proud of its association with this significant project. It's another example of "Engineering in Action" to provide power for better living from any source, whether it be water, steam, oil, or the atom itself.



Direction of over-all design and construction phases as well as design and manufacture of reactor core and control rod devices was by Argonne National Laboratory.

Power Equipment Supplied by Allis-Chalmers

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- Auxiliary cooling water pumps
- Motor control centers
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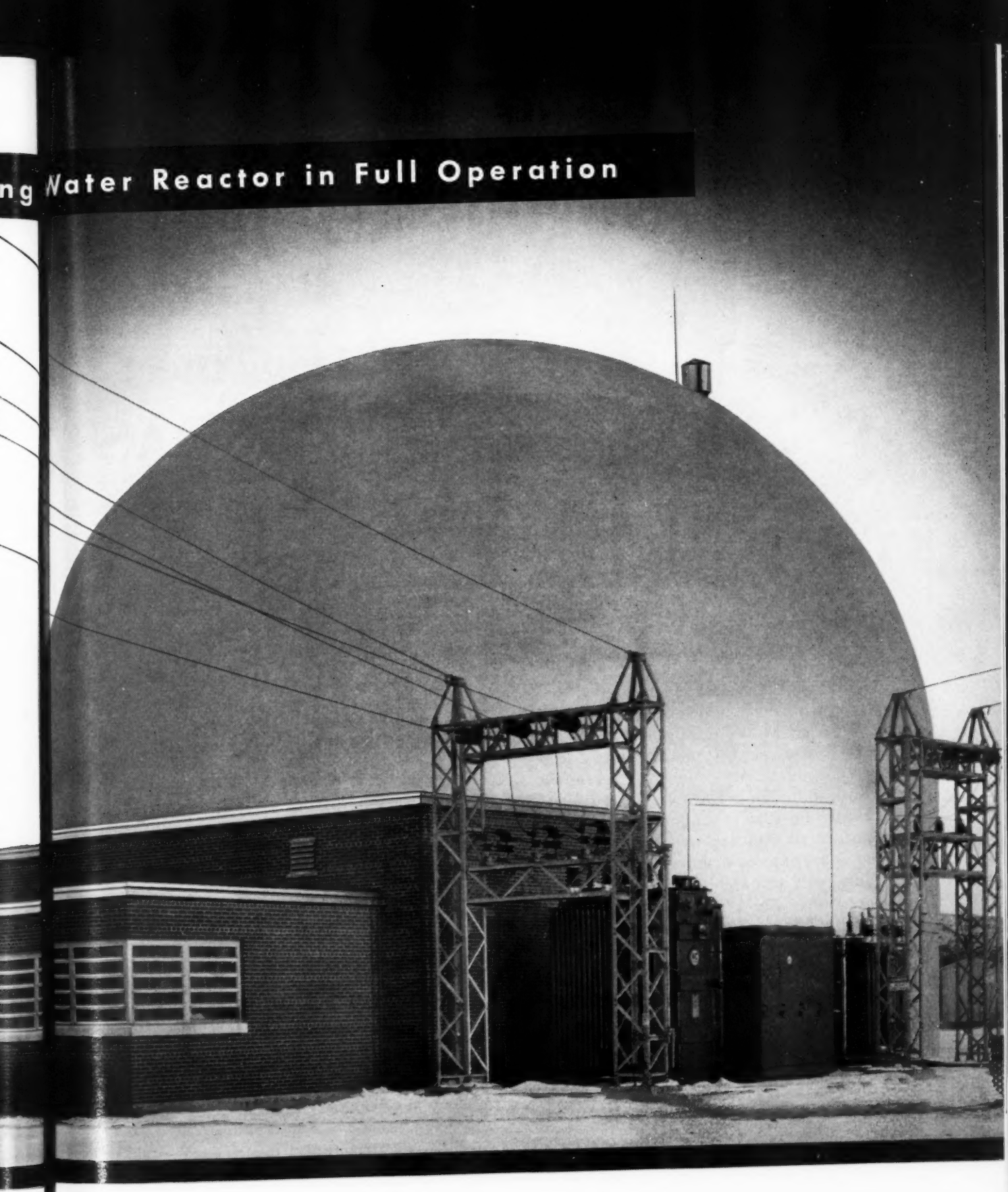
- Indoor and outdoor switchgear
- Automatic voltage regulator
- Circulating water treatment system
- Ac-dc distribution center
- Diesel-generator set

ng Water Reactor in Full Operation



ALLIS-CHALMERS

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Report from the WEST COAST

PECOS CALAHAN
Executive Secretary
Consulting Engineers Association of California

CALIFORNIA ENGINEERS are faced with the problem of defending, opposing, or taking a neutral stand on five percent of the total bills introduced in the current session of the California Legislature. A digest, prepared by the Legislative representative of the California Legislative Council of Professional Engineers, reveals that approximately 360 current bills affect or are of more than passing interest to engineers, surveyors, and architects, especially those in private practice.

Many of the bills deal with some phase of public construction (such as highways, bridges, buildings, structures, and water resources) and are not objectionable in their present form, but there is always the possibility that an amendment will be introduced later that would be objectionable to the engineering profession. Therefore, all such bills will be watched throughout the session.

State, Engineers in Competition

In addition, there are a number of bills that authorize certain State agencies to render engineering services to local governing bodies. This, in effect, would place the State in competition with engineers in private practice. All such bills will be opposed strongly by the Legislative Council. However, the outlook for defeating the measures is not too bright because of their strong political backing.

Although several bills have been introduced amending the Professional Engineers Act, most of them were sponsored by the California Legislative Council of Professional Engineers. No attempts have been made so far to amend the Act to provide for a lay member on the Registration Board, as recommended by the Governor's Council, in 1952.

Amendments to Engineers Act

Amendments to the Professional Engineers Act (incorporated in several bills) would:

¶ Extend the life of the Engineer-in-Training certificate from 8 to 12 years.

¶ Increase years of experience required for professional engineers classification from six to eight years.

¶ Increase the salary of the Executive Secretary.

¶ Require all applicants for temporary registration to appear before the Board and demonstrate satisfactory evidence of knowledge of the application of seismic forces in the design of structures, or adequate knowledge in any other phase of engineering for which the applicants propose to practice under temporary authorization.

¶ Amend disciplinary proceedings, with the changes more or less of a technical nature.

Of particular interest to structural engineers and architects is a bill amending the so-called "Field Act," which governs the design of public school buildings, with specific consideration given to seismic forces. The present law requires that all plans and specifications for public school buildings shall be prepared by an architect or a civil engineer, who has been authorized by the Board of Registration to use the title "Structural Engineer." The amendment merely changes the word "shall" to "may," which would make it permissive and not mandatory that an architect or structural engineer be engaged by the

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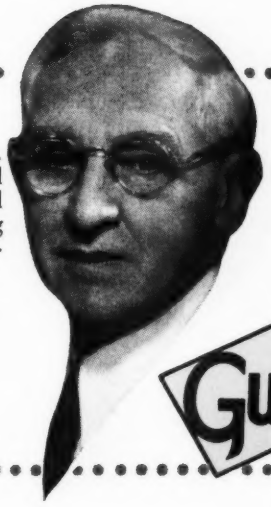

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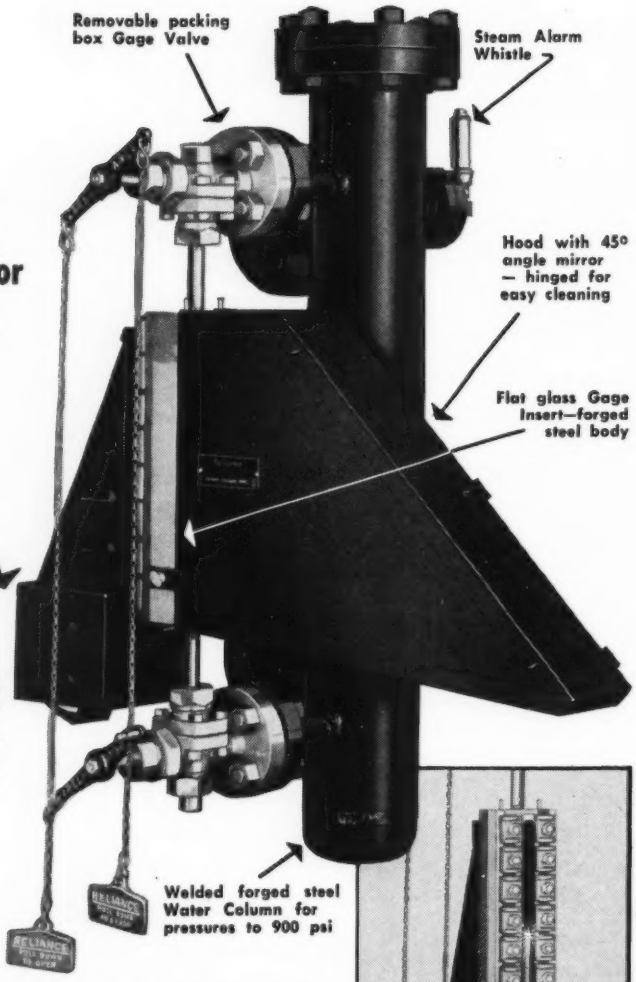
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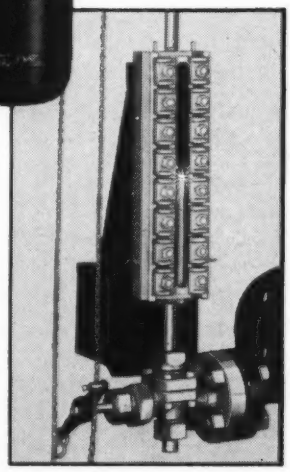

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School District. Should this bill pass, the purpose for which the Field Act was made a law in 1933 would be destroyed — the design of school buildings to resist earthquake forces.

Would Limit Fees

Of concern to architects and engineers is a bill that would limit the fees to be paid for the design of any public works. "Public works" is defined as the improvement of any bridge, building, or structure. The bill, if passed, not only would apply to State work, but also would include projects in any county, city, and political subdivision. Fees to be paid for professional services, under the provisions of the bill, are 6 percent of the cost of the first $100,000 of construction; 5 percent of the next $200,000; 4 percent of the next $200,000; and 3½ percent of all over $1 million.

Superfluous Bill

The United Designers, Inc., is the sponsor of a bill that would create a new law known as the "Building Designers Act." The proposed statute is intended to license as a separate occupation "building designers." A licensed building designer, under terms of the bill, would be authorized to prepare plans and specifications and to supervise construction of buildings not exceeding two stories and basement in height. The designers could work either independently, or in association with or under the direct supervision of a registered civil engineer. Architects and engineers contend that the passage of such a law would serve no real purpose because the type of buildings authorized to be designed under the act is exempt from the engineers act and also is exempt from the architects act, providing the designer notifies his client that he is not an architect. Similar bills have been introduced and defeated in the past.

The United Designers, Inc. is a group of draftsmen actively engaged in the preparation of plans and

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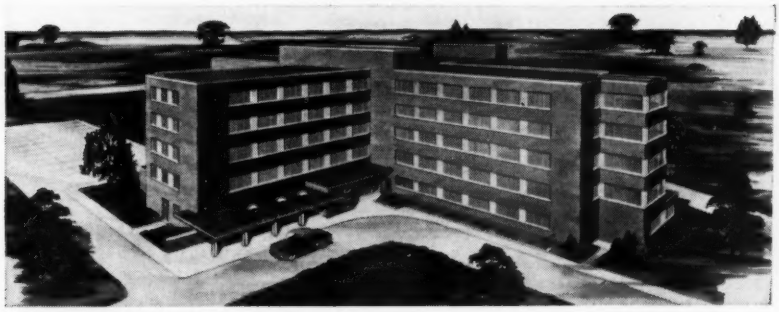

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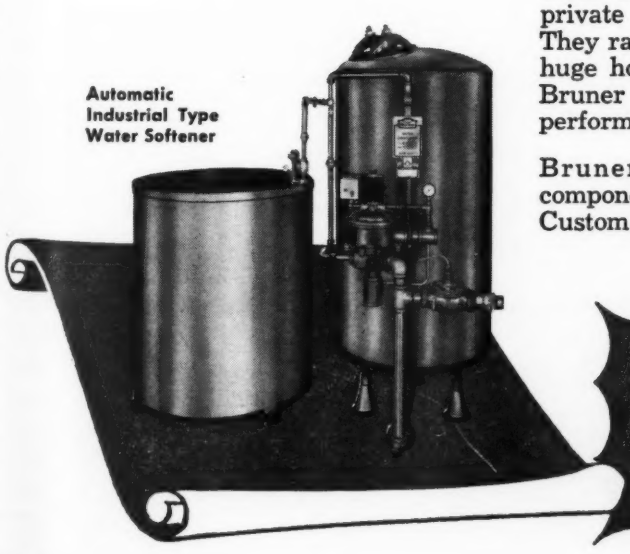

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specifications for dwellings and small commercial buildings. They are not required to be licensed to continue their activities, and it appears that the only reason for such a law is the prestige that it might give to those getting the new licenses. Members of the group, either by choice or for some other reason, have not been able to become licensed as architects or to be registered as civil engineers.

Defense Council

The California Legislative Council of Professional Engineers is a permanent organization with the sole purpose of defending the engineering profession against unfavorable legislation. The Council is the spokesman for the engineering profession in California, where legislation is concerned. Its membership consists of the four Sections of the ASCE; the two Sections of AICHE; the San Francisco and Los Angeles Sections of AIEE; the Northern and Southern Sections of ASME; the Structural Engineers Associations of Northern and Southern California; the Consulting Engineers Association of California; the Bay Counties Civil Engineers and Land Surveyors Association; the Civil Engineers and Land Surveyors Association of California; the San Diego Civil Engineers and Land Surveyors Association; and the County Engineers Association.

Attorney on Call

The aggregate membership of the 17 affiliate groups in the Council is more than 25,000. The Council is represented before the Legislature by an attorney who maintains an office in Sacramento. He has been on the Council payroll for several years, and is subject to call at all times, even when the Legislature is not in session.

George E. Brandow, structural engineer, Los Angeles, is president of the Council. G. M. Simonson, mechanical engineer, San Francisco, and Arnold Ames, chemical engineer, Los Angeles, are vice-presidents. ▲▲

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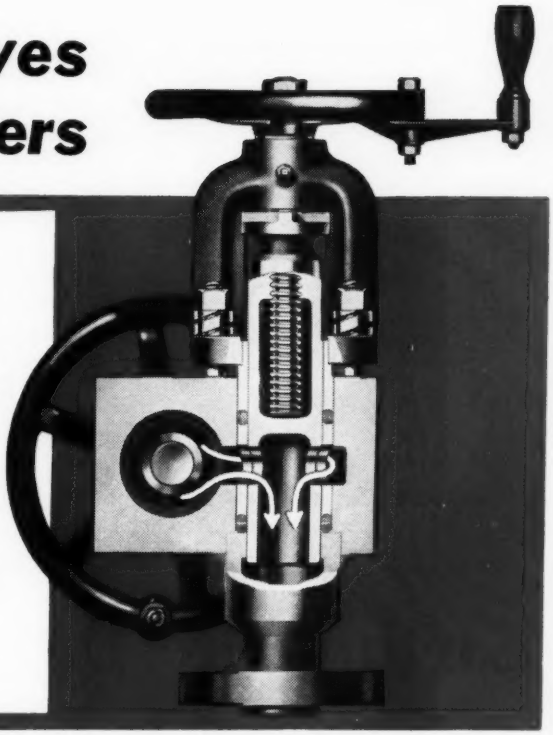
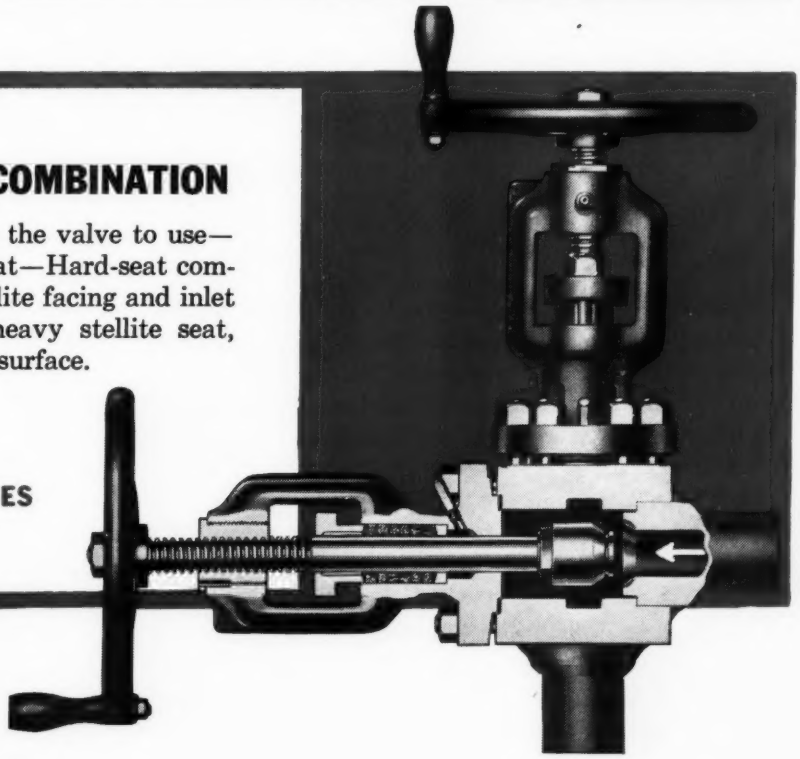


HARD-SEAT—SEATLESS COMBINATION

■ For boilers up to 1500 psi, this Yarway Unit Tandem Blow-Off Valve offers the maximum in dependable service. A one-piece forged steel block serves as the common body for the Yarway Stellite Hard-seat blowing valve and the Yarway Seatless sealing valve. All interconnecting flanges, bolts and gaskets are eliminated. The Unit Tandem at right is sectioned through Seatless Valve to show balanced sliding plunger in open position and free flow.



HARD-SEAT—HARD-SEAT COMBINATION

■ For boilers to 2500 psi, this is the valve to use—Yarway's Unit Tandem Hard-seat—Hard-seat combination. Disc has welded-in stellite facing and inlet nozzle has integral welded-in heavy stellite seat, providing smooth, hard-wearing surface.

OVER 4 OUT OF 5
HIGH PRESSURE PLANTS
USE YARWAY BLOW-OFF VALVES

Write for Yarway Catalog B-434

YARNALL-WARING COMPANY
106 Mermaid Ave., Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY **BLOW-OFF VALVES**

Tokyo University

THIS REINFORCED CONCRETE BUILDING WAS DESTROYED IN THE FUKUI, JAPAN, EARTHQUAKE, IN 1948.

Earthquake Damage Can Be Controlled

KARL V. STEINBRUGGE & VINCENT R. BUSH
Earthquake Department
Pacific Fire Rating Bureau

CE exclusive

THE PROTECTION of life and property against earthquakes is quite naturally the responsibility of the consulting engineer whenever he is commissioned for a new structure or facility. While the structural engineer may readily recognize his responsibility, often the electrical, mechanical, and other engineers are not sufficiently aware of the hazard as it pertains to their design.

It is fallacious to think that damaging earthquakes in this country are confined to California or to the western states. Probably the heaviest earthquakes in the United States occurred in Missouri, during 1811 and 1812.[1] In this earthquake, areas in terms of square miles were uplifted many feet; other areas sank and formed "broad, shallow, and essentially permanent bodies of water." Charleston, South Carolina, experienced a strong earthquake in 1886; upper New York and the St. Lawrence Valley have had damaging shocks, as have other areas.[2]

Earthquake intensity is not necessarily related to earthquake frequency. The very strong earthquakes of 1811-12 were not followed by frequent, strong, damaging shocks. Thus, the consulting engineer, when designing a structure, should give careful consideration before providing lateral force resistance for "¼ an earthquake" or "½ an earthquake" as some building ordinances allow.

Western Earthquakes

Historically, the far west and particularly California have been subject to many damaging earthquakes. The San Francisco earthquake (1906), Santa Barbara earthquake (1925), Long Beach earthquake (1933), Imperial Valley earthquake (1940), Tehachapi — Bakersfield (Southern California) earthquakes (1952), and others, clearly indicate the earthquake hazard in California and, in the later shocks, the effectiveness of earthquake bracing procedures.

States of Washington, Utah, Montana, and Nevada have had damaging earthquakes in the last several decades. The consulting engineer should review the earthquake history for any location under consideration in a far western or Rocky Mountain state.[3]

This is particularly true for the rural areas where there may be little precedent and poor building codes for his guidance.

Earthquake Faults

National magazines, plus the daily press, have overemphasized earthquake faults. Their description of the San Andreas fault as the "master fault of California" has raised many questions on site location with respect to faults.

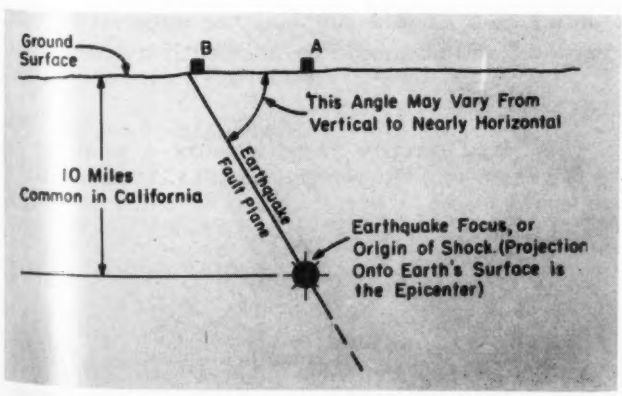
We often hear it said, for example, that a structure several miles away from an earthquake fault on which an earthquake occurs is safer than one a few hundred yards from the fault. In the drawing, building A is directly over the earthquake while building B is very close to the surface trace of the fault. If the movement on the fault is restricted to the immediate vicinity of the focus, then building A is closer to the shock than building B, yet B is nearer the fault.

In the event the fault movement extends to the the earth's surface, as it has in many major western United States earthquakes, it has been suggested, and also substantiated by some experience, that the heaviest damage need not occur in the immediate vicinity of the fault's surface trace, provided that faulting does not go through the structure.[4]

Within broad limitations, the farther a structure is from a known fault, the better. Unfortunately, in earthquake active areas, the farther a structure is from one known fault, the closer it may become to another. For example, a detailed fault map of the Los Angeles (California) basin shows the region to be crisscrossed by a maze of faults. It would be difficult to find a location that would be over three or four miles from a known fault.

Predicting Earthquakes

Science has not yet been able to accurately predict earthquakes as to time, place, or intensity. Studies have been made attempting to correlate the effects of tides, stars, moon, sunspots, and weather, but to date all have proven nonconclusive.


Ground Surface
B
A
This Angle May Vary From Vertical to Nearly Horizontal
10 Miles Common in California
Earthquake Fault Plane
Earthquake Focus, or Origin of Shock. (Projection Onto Earth's Surface is the Epicenter)

BUILDING B IS CLOSER TO THE EARTH FAULT, BUT BUILDING A IS CLOSER TO THE FOCUS OF THE QUAKE.

KARL V. STEINBRUGGE

Karl V. Steinbrugge attended Oregon State College and was graduated with a B.S. in Civil Engineering in 1941. While in college he was elected to Tau Beta Pi and Sigma Tau. His military service in World War II was in the Navy. After his discharge he was reemployed in Oakland, Calif. by the Austin Company as a structural designer. This was followed by two years in the school section of the California Division of Architecture.

In 1950, he joined the Pacific Fire Rating Bureau. At present, he is the head of their Earthquake Department. His duties include the structural analysis of buildings to determine their earthquake resistance. After strong earthquakes, he directs the investigation of the damage effects. He has published several studies on earthquakes, including the Tehachapi-Bakersfield earthquakes of 1952 and the Nevada earthquakes of 1954. In addition, he has given an average of 15 to 20 public lectures each year on earthquake effects. He is a registered structural engineer in California and is a member of the Structural Engineers Association of Northern California, American Society of Civil Engineers, and the Earthquake Research Institute. He teaches a course in structural engineering to graduate students in architecture at the University of California.

VINCENT R. BUSH

Vincent R. Bush is a graduate of the University of Southern California with a Bachelor of Engineering degree and a Master of Science degree in Civil Engineering. A registered civil and structural engineer in California, Mr. Bush has had approximately nine years experience in structural engineering. Five and one-half years have been with the Earthquake Department of the Pacific Fire Rating Bureau, with the last year and one-half in charge of the Los Angeles Earthquake Department.

He is currently teaching a class in reinforced concrete design at the University of Southern California. Present work involves the checking of all types of buildings and structures to determine their earthquake resistance, and estimate the probable damage during a severe earthquake. In addition field studies are made after an earthquake to investigate and correlate the damage patterns of buildings and structures.

While the prediction of earthquakes may become possible in the future, our best guide for the present is the record of past earthquake history.

The consulting engineer's problem is one of preventing life loss and minimizing property damage instead of predicting earthquakes. Fortunately, the engineer's objective is, to a large degree, attainable.

Structural Aspects

The structural engineer must design his building to resist strong, lateral, extremely chaotic forces. The ground motion of past earthquakes has not yet been

DETAIL OF DAMAGE DONE TO A REINFORCED CONCRETE COLUMN IN THE 1933 LONG BEACH QUAKE.

THIS PUBLIC SCHOOL WAS COMPLETELY DESTROYED IN THE WELL-REMEMBERED LONG BEACH QUAKE.

THE TEHACHAPI EARTHQUAKE, 1952, BROUGHT ON FAILURE OF PIPE SUPPORTS AT PALOMA REFINERY.

exactly described in mathematical terms usable to the engineer. Data, however, have and are being developed that allow a more rational understanding and rational approach to design. But by no means should present methods be considered precise.

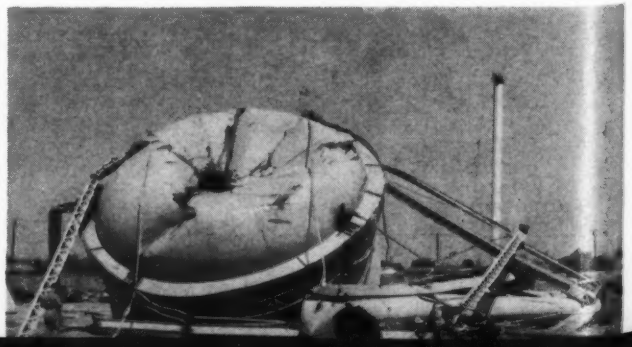
In essence, design for earthquake bracing of a building must consist of a logical system having any or all of the following: continuous building frame, shear ("bracing") walls, X-bracing (horizontal, vertical, or slanting), floors and roofs able to act as diaphragms, knee bracing, and other methods. Often neglected, but of utmost importance, is the effect of the relative rigidity of the various bracing elements. It is also important to consider torsion resulting from unsymmetrically placed bracing elements.

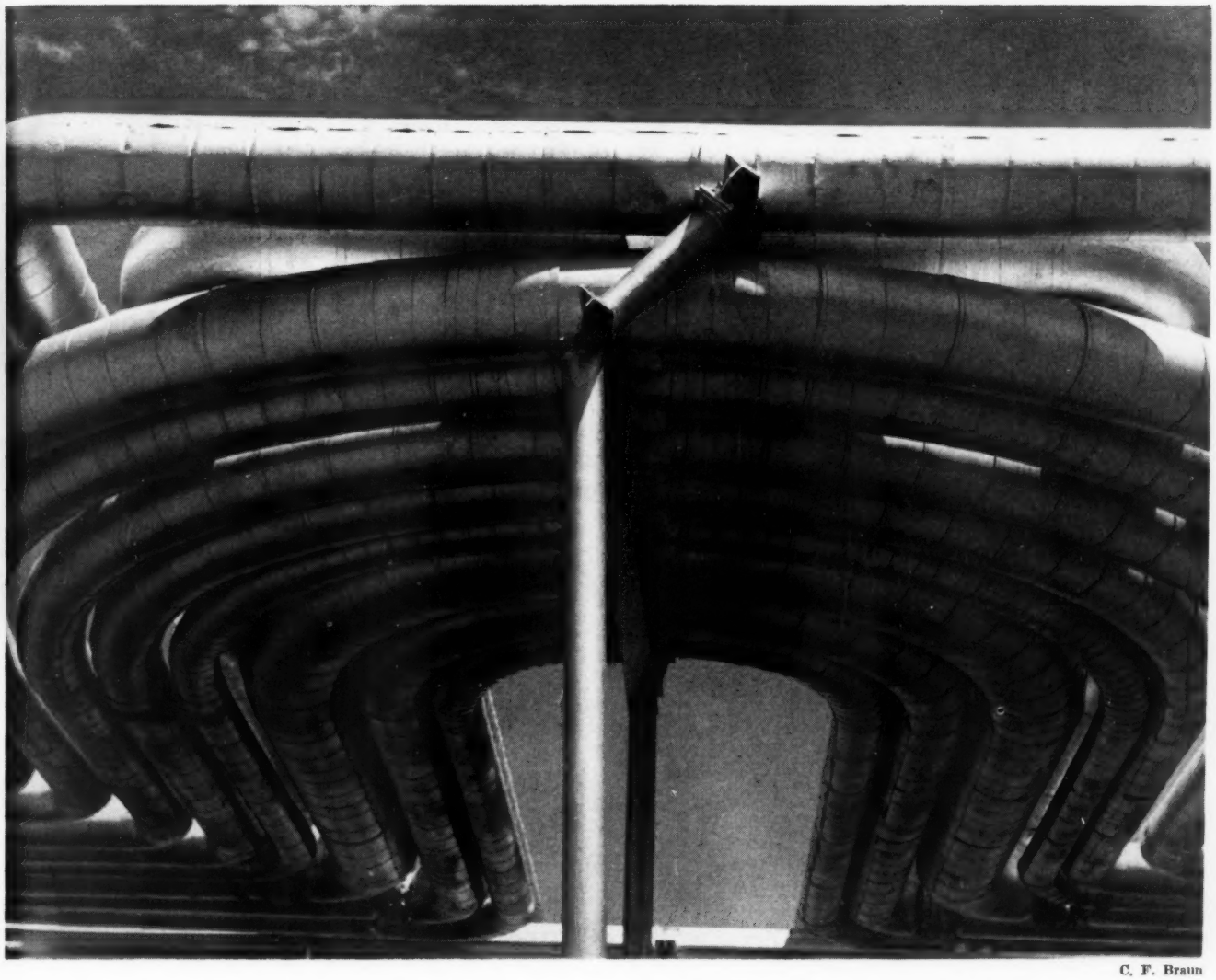
The earthquake force applied to the bracing system comes under Newton's second law of motion wherein the transient earthquake forces are a function of a chaotic ground motion and the structure's mass. Building codes contain coefficients intended to reflect the dynamic earthquake forces as equivalent horizontal static forces. Mathematical or detailed discussions of the nature of the earthquake motion and resulting forces have been published, as have discussions of earthquake spectrum, damping factors, soil response, and other items. Empirical coefficients in general have produced safe buildings, and the results of earthquake experience should not be taken lightly by the designer.

Code Limitations

The actual determination of forces to be applied to a structure may be spelled out in a building code, but in some instances the values are too low. No building code should supplant the engineer's good judgment, and he should be sufficiently aware of the

THIS 100,000 GALLON TANK WAS ON A 100-FOOT TOWER BEFORE THE 1952 TEHACHAPI EARTHQUAKE.





C. F. Braun

nature of earthquake forces and bracing methods to recognize code requirements that are insufficient.

The largest area of confusion at present appears to be in assigning or assuming responsibility for earthquake damage control. The primary purpose of a building code is to protect life. Some codes have been developed solely on the basis of safety against major structural damage in the event of a precedented earthquake with no or little code consideration of the protection of architectural trim, partitions, plumbing, heating, electrical equipment, exterior panel walls, veneers, and other items making up the bulk of the value of the structure.

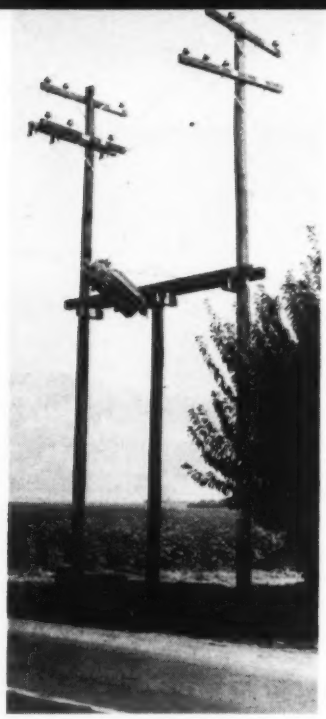
Consultant's Responsibility

Thus the engineer is confronted with protecting his client's investment by limiting or controlling deflections due to earthquake forces when damageable elements of considerable value exist. The terms "rigid bracing" (as shear walls) and "flexible bracing" (as building frame in bending), along with their relative safety in an earthquake, often have been used in heavy debate. Since, however, it seems plausible that the consulting engineer, in return for his fee, does have a moral obligation towards protecting the owner's investment, then the engineer must consider damage control in his design.

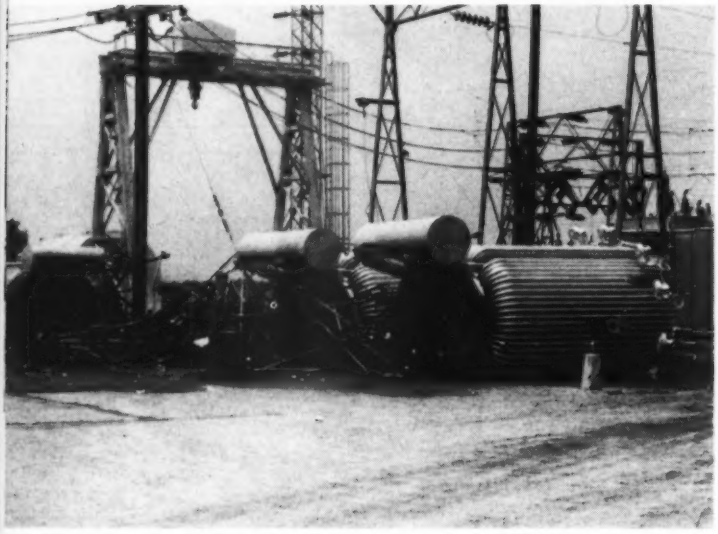
Special attention should be called to the building code used in connection with public school construction in California. Known as Title 21, it has been in the forefront in developing knowledge on lateral force bracing assemblies and in insisting on good construction through the means of adequate resident inspectors. As a result, lack of damage to public schools constructed under its provisions has been outstanding in the 1940 and 1952 earthquakes, especially when compared to the general destruction witnessed in the 1933 Long Beach earthquake.

Historically, certain materials, such as unit masonry, are linked with serious damage in earthquakes. On the other hand, structures of light mass, such as wood frame, generally have performed quite well. However, developments over recent years have allowed practically all materials to become suitable for earthquake resistive construction even though the degree of suitability has not been firmly established in all instances.

For example, better knowledge of mortars and



ELECTRICAL EQUIPMENT IS OFTEN WRECKED. HERE BOTH POLE AND GROUND TRANSFORMERS WERE DAMAGED EXTENSIVELY.



grouts, along with the use of reinforcing steel, have led to an assembly known as reinforced grouted brick masonry. This assembly has strength in compression, tension, and shear, and has proven reasonably successful in recent moderate earthquakes. Hollow concrete block has been similarly developed.

New Techniques

Construction consisting of wood floors supported by masonry walls often has been associated with damage. Newer techniques, however, in which the floors and roofs have been designed as diaphragms to walls which possess shear, tensile, and compressive strengths have proven adequate.

Cost of earthquake resistive construction is nominal when the design is handled by an experienced consulting engineer. Admittedly, costs do increase somewhat for tall, multistory structures or unusual arrangements. Usually in the preliminary design such items as location and size of wall openings, location of elevator shafts, choice of materials, and similar items are in a fluid state. It is then that the consulting engineer's advice can and should be made known. Too often, high costs for earthquake bracing can be associated with poor preliminary planning, architectural insistence on special effects, or insufficient knowledge on the part of the consulting engineer.

Mechanical Engineering Aspects

The history of the Paloma Cycling Plant in the 1952 Southern California earthquake is interesting. Earthquake damage was minor, since the plant was designed to resist strong lateral forces, but the ensuing explosion and fire caused extensive damage. The earthquake broke some high pressure process piping and an incoming field gas line. The supports of two of the five butane spheres collapsed, and the heavier than air gas from the two (2500 barrel) spheres spread throughout the plant. In about three minutes the gases ignited, and the resulting explosion set fire to the plant. Some earthquake damage was noted such as stretched anchor bolts on the tall processing towers, but usually it was not too important.[5]

The consulting engineer should give careful consideration to good anchorage of equipment. The fact that a piece of equipment may have large mass does not prevent it from sliding or turning over. Piping layouts must be designed with care, and brittle materials such as cast iron pipe must be guarded against earthquake impact loadings. Process columns, which possess small amounts of damping as compared to conventional tall buildings, may be subject to earthquake forces considerably in excess of those specified in most codes.

Piping within the building and that supported by the building can be more rigid than the building itself. An extreme example of this is a large area, high story height woodworking plant, where the sprinkler piping may be more rigid than its supporting wood structure. The careful use of flexible connections and properly placed pipe anchorages are mandatory.

Underground piping is subject to heavy damage in marsh and filled ground areas. If piping is to go into these poor ground areas, then proper planning should consider bypasses and shutoffs. Need for this type of planning was most clearly demonstrated in the 1906 San Francisco Earthquake.[6]

Large diameter ground level steel tanks, such as those used for oil storage, are subject to damage resulting from the contents sloshing and the tank shifting. Damage from the sloshing of contents was noted in the 1933 and 1952 moderate California earthquakes. It resulted primarily in the destruction of floating tops and damage to fixed tops. In major earthquakes tanks may shift and break their pipe connections; tank shifting is a function of the coefficient of friction between the tank and the ground, of the effective mass of the liquid as determined by the shell stiffness and shape, vertical earthquake ac-

celeration, and other factors. When it is desirable to protect the tank contents because of its monetary value or its disaster value (water for fire fighting), then flexible connections should be provided for an unanchored tank, or sliding should be prevented by pouring a concrete ring around the tank.

Electrical Engineering Aspects

The consulting electrical engineer also is faced with equipment anchorage problems. Motors are well anchored as a matter of course, but panel boards in the middle of a room rarely are. Shifting or overturning of these control boards can completely immobilize a highly earthquake-resistant plant.

Hospital, police, and other essential facilities frequently have standby power equipment which requiries batteries; these batteries may be on shelves from which they will fall in an earthquake. Small guards, perhaps ½-in. high, can hold them in place.

Transformers mounted on platforms between power poles often have fallen in past earthquakes. For example, in the southern California earthquake in 1952, a total of 846 pole transformers fell off their platforms. Standards of at least one large Pacific Coast utility require bracing to withstand quakes. Two or more utilities design their facilities for 100 percent over that required by most building codes, their reasoning being that a public utility must operate through a major disaster.

Earthquake problems also extend to such items as light fixtures. In the 1952 earthquake "literally miles of fluorescent fixtures fell."

Foundation Engineering Aspects

The relationship between ground motion in various soils and building damage effects need much more study. Very recent seismographic data from southern California again indicates that the actual ground motion in rock is far less than in alluvial materials. Their preliminary studies indicate that the maximum amplitudes possibly could vary tenfold.[7] Experience in practically all earthquakes[8] indicates that more damage is found in poor or filled ground areas than on rock or other very substantial material. Admittedly, some conflicting opinions exist. The explanations for the greater damage on poor ground are complicated by the strains and cracks in buildings which have resulted from differential settlements prior to the earthquake. Furthermore, the definition of "good ground" and "poor ground" has not been uniform and may lead to divergent results.

The problem is difficult, and experienced foundation information is necessary for all installations on mud flats or filled areas. In recent years there have existed tendencies to minimize foundation problems or to take a calculated risk with respect to earthquake, possibly because the problems are not clearly understood. ▲▲

GROUND BREAKAGE CAN BE SEVERE IN POOR SOIL AREAS. THIS IS RESULTS OF FALLON QUAKE IN 1954.

Bureau of Reclamation

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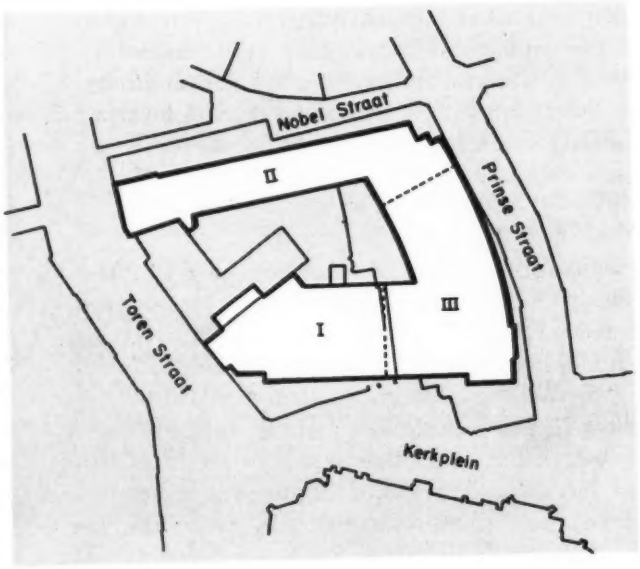


FIG. 1—CONSTRUCTION OF POST OFFICE AT THE HAGUE WILL BE IN 3 STAGES, AT 2-YR INTERVALS.

IR. J. A. VAN HEERDE, C.I.
Consulting Engineer
's-Gravenhage, The Netherlands

DR. H. Q. GOLDER
Director, Soil Mechanics Limited
London, England

Solving a Problem in Soil Stabilization

THE PURPOSE of an injection process in foundation work is to change the properties of the soil — reduce the permeability, increase the strength, reduce the compressibility, or any combination of the three. The particular method used depends on the type of soil treated, the area and volume, and the results required. At present, chemical injection is used primarily where the soil must be undisturbed because of adjacent buildings, where excavation must be carried out in pervious soils below the water table, and where it is necessary to form cut-offs under dams or to prevent infiltration into underground structures.

The foundation engineer deals with soil masses, made up of individual particles varying in size from coarse gravel to colloidal clay grains. In soil masses the spaces between mineral particles contain air, water, or both. Injected chemicals replace the air and water, in effect cementing the soil particles together or filling the voids to prevent water infiltration.

The most familiar process uses a solution of sodium silicate in water (water glass). Adding salts (calcium or magnesium chloride) or acids produces a gel.

Silicate injections are effective down to the fine sand range. Their use results in a soil mass of low permeability and fairly high strength. The injections can consist of one chemical with a delaying agent or two separate injections of two different chemicals. The single solution processes generally are cheaper when large volumes of material are to be treated, but with them it is more difficult to control the placing of the injected material. They are used mainly for stopping large flows of water—under dams, for instance—or for treating extensive excavations. For underpinning and tunneling work the two-solution methods are considered better and more controllable than the single-solution processes.

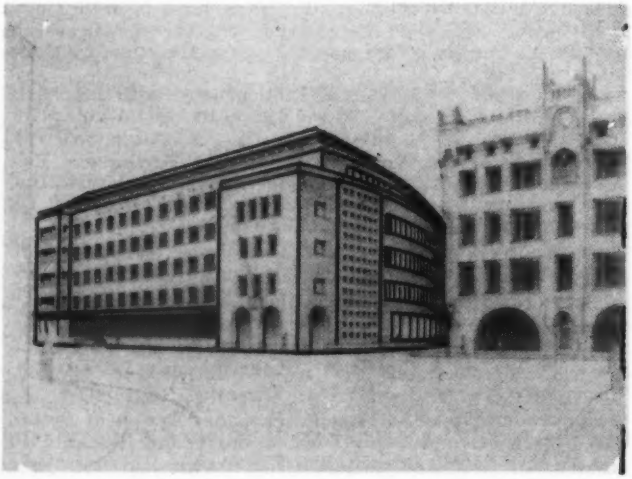


FIG. 2—SOIL UNDER OLD TELEPHONE BUILDING HAD TO BE STABILIZED BEFORE DIGGING NEW FOUNDATIONS.

Post Office at The Hague

Chemical injections were used successfully on a difficult job recently undertaken in The Hague, Holland. The new post office in The Hague will be made up of three buildings to be constructed at two-year intervals. This will facilitate moving of telephone equipment from the existing buildings on either side of the site. In the Netherlands, mail, telephone, and telegraph services all are controlled by one govern-

ment agency — the Post-Telephone-Telegraph Authority. The old buildings will be razed one at a time to make room for the second and third phases of construction. Fig. 1 shows the relative position of each of the phases. The portion marked 'I' is the section discussed here.

Before proceeding with excavation for the foundation of the first section of the new post office, it was necessary to stabilize the sandy soil by chemical injection to prevent settlement of the old post office and the old telephone office buildings on adjacent sites. This first building, just completed, is 104-ft high with a 20-ft deep cellar for the heating and air conditioning plant. This cellar is only three feet from the foundation wall of the old post office. Driving of steel sheet piles to retain the sand was impossible, since the old building's foundation is overloaded, and the structure itself is in very poor condition. On the opposite side, the new structure was erected against an old telephone office building, with the new foundation lower than the existing basement. Fig. 2 is an artist's rendering of the completed building, showing the old telephone office building on the right.

Tests run by Soil Mechanics Ltd., of London, indicated that a two-solution chemical grouting procedure could be used to retain the sandy soil during excavation without endangering the old buildings. The Guttman process used consists of first injecting sodium silicate and sodium carbonate and later injecting calcium chloride.

Through Perforated Pipes

The chemicals were injected into the ground through perforated pipes. Each pipe was driven in stages, the silicate and carbonate mixture being injected as the pipe was driven in, and the chloride being injected as the pipe was pulled out. Boiler feed type pumps driven by compressed air were used to produce pressures up to 400 psi. Air hammers were used to drive the pipes into the ground, and air also was used to promote solution of the chemical.

Before injection of the chemicals, all hollow spaces under the basement floor of the old post office (Fig. 3) were grouted with cement to prevent injection materials from seeping up into them.

Three separate sets of injections were made under the old foundation. The first two were made from the outside, the last through holes bored in the old wall. The three striated sections show the approximate path of the chemicals.

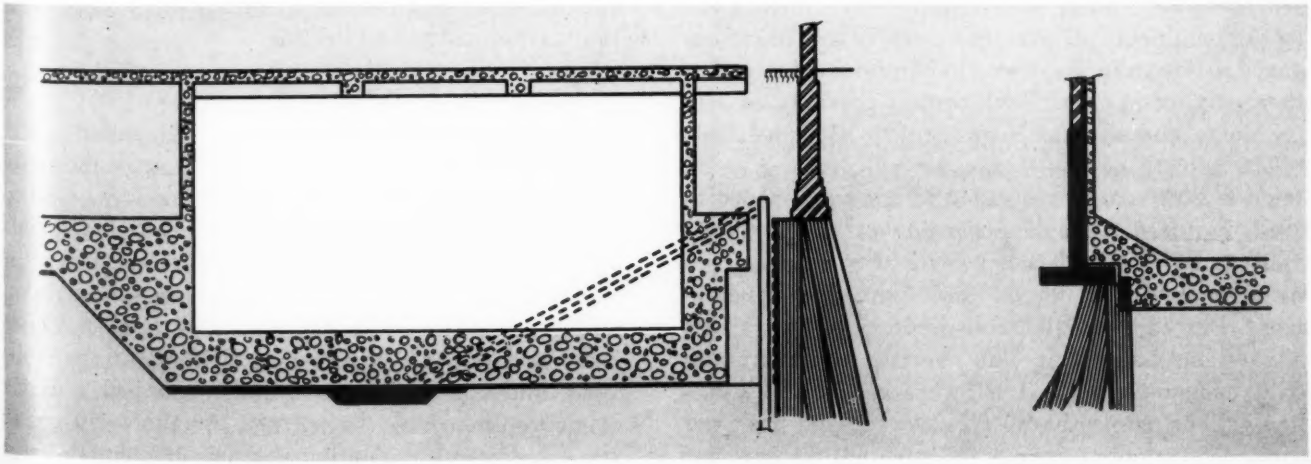
To Prevent Slipping

Since soil tests had indicated thin layers of clay (clay soils are too fine-grained to be injected), it was necessary to provide supplementary support to prevent slipping of the injected area during excavation. This was accomplished by leaving a bank of sand, sloping downward from the bottom of the old footing to the maximum excavated depth, along the existing wall. Then steel pipes were bored into the soil at intervals, and timber walings were inserted to support the stablized wall as the remaining sand bank was removed. The tops of the steel pipes were supported by raking steel struts.

On the other side, where the new post office is constructed against the old telephone office building (Fig. 4), the new foundation is three feet lower than the old basement. Chemical injection was used under the old footings, as shown in Fig. 4, to prevent settlement of the old building. The same system of stabilization also was used successfully on the other two sides of the excavation.

In actual practice, an injected sand wall does not have the regular contour indicated in the composite drawing of Figs. 3 and 4.

Samples of the injected soil showed a compression strength of from 250 to 700 psi, depending on origin of the sample and pressure on the sides of the test cubes, which varied from 0 to 140 psi. These results indicate a shear strength of about 70 psi. There has been no measurable settlement of the old buildings. ▲▲



FIGS. 3 & 4—STRIATED SECTIONS SHOW INJECTIONS UNDER OLD POST OFFICE (LEFT) AND TELEPHONE BUILDING.

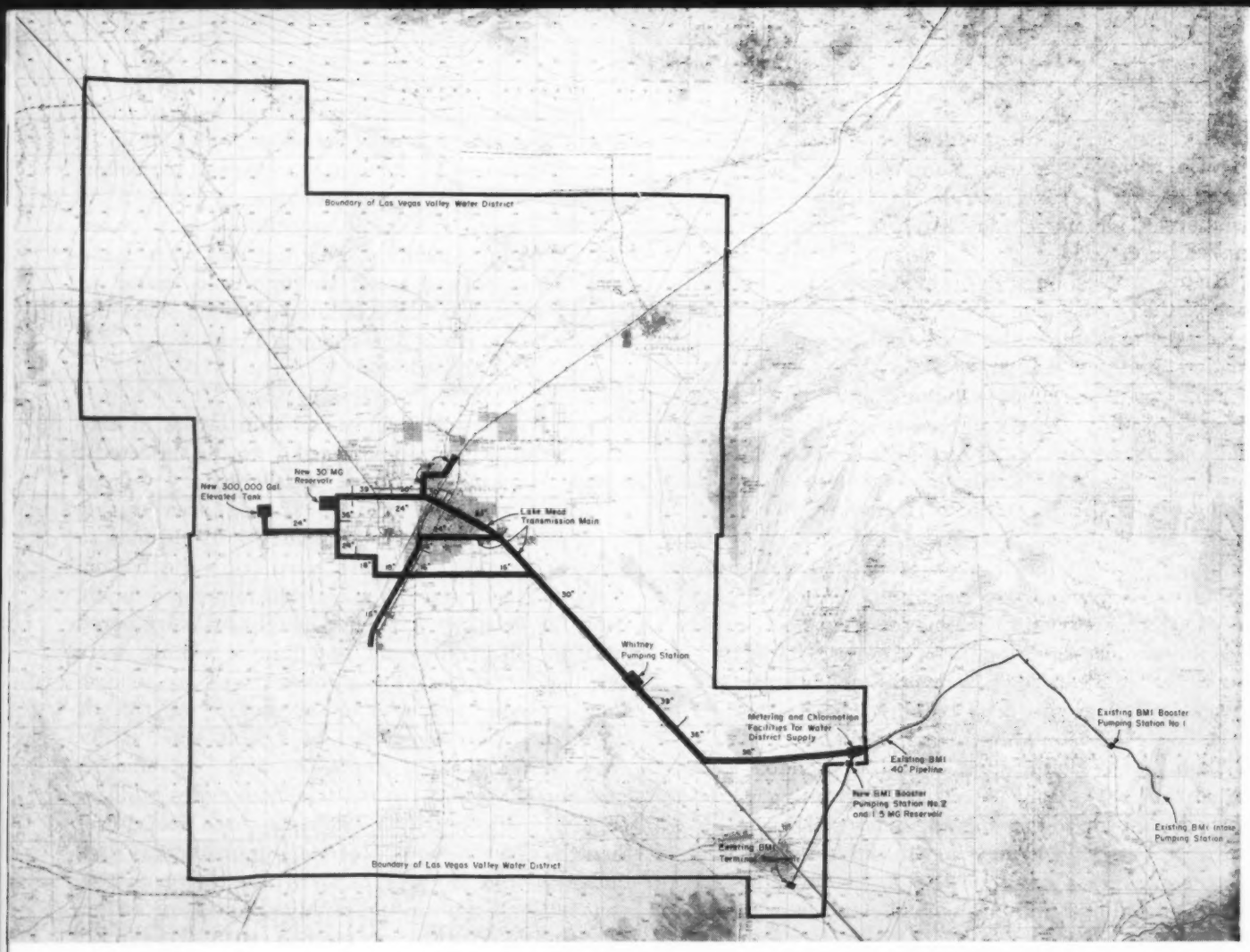

Boundary of Las Vegas Valley Water District
New 300,000 Gal. Elevated Tank
New 30 MG Reservoir
Lake Mead Transmission Main
Whitney Pumping Station
Metering and Chlorination Facilities for Water District Supply
Existing BMI 40" Pipeline
New BMI Booster Pumping Station No. 2 and 1.5 MG Reservoir
Existing BMI Booster Pumping Station No. 1
Existing BMI Intake Pumping Station
Existing BMI Terminal Reservoir
Boundary of Las Vegas Valley Water District

FIG. 1—MAP OF LAS VEGAS VALLEY WATER DISTRICT SHOWING NEW SYSTEM AND LOCATION OF LAKE MEAD.

Designing a Supplemental Water Supply

AS CITIES AND TOWNS increase in population, the first growing pains are those brought on by outgrown utilities. An inadequate water supply hurts most. Consulting engineers all over the country are being engaged to design new systems to handle the demand of these expanded cities. Each project presents its own problems, and our Las Vegas project had its share.

The growth of Las Vegas, Nevada, from a small town of 8000 persons in 1940 to a city of 50,000 in 1956, required a major expansion of water supply facilities. This population growth was accompanied by extensive commercial and industrial development. Per capita water consumption in Las Vegas always has been high. The average and maximum daily consumptions, in 1956, were 18.0 and 31.2 million gallons, respectively. The average and peak per capita consumptions were 383 and 664 gallons per day. This high per capita water consumption is due partly to the hot, dry climate and partly to the fact that, in the past, water had been sold on a flat rate basis. However, meters gradually are being installed, and when all services are metered, water consumption undoubtedly will decline.

Original Water Supply

Las Vegas Valley, in the past, depended upon large springs for water. These springs were the early settlers' only source of water supply and were of vital importance to the San Pedro, Los Angeles, and Salt Lake Railroad (now the Union Pacific) when it built the railroad and established Las Vegas as a division point with large repair shops. In 1905, the Las Vegas Land and Water Company, a subsidiary of the Railroad, laid out the townsite and developed a water system supplied by the springs. As the town grew, the supply from the springs became inadequate, and in 1924, the Water Company started drilling artesian

wells to supplement the spring supply. During recent years, with individually-owned wells scattered all over the valley, the artesian basin has been overdrawn at a rate of over 15,000 acre feet per year.

Realizing that the future growth of the entire community would be limited if the underground supply alone were depended upon, the electorate of the Las Vegas Valley, in 1948, voted to form the Las Vegas Valley Water District. The function of the District was to be two-fold, first to operate as a public utility supplying water to consumers within the District boundaries, and second, to cooperate with the State Engineer of Nevada to regulate withdrawal of water from the underground basin.

Alternate Methods

In order to supplement the ground water supply, consideration was given to importing Colorado River water from Lake Mead, a distance of some 23 miles. Preliminary estimates showed that the cost of a pipeline and pumping facilities of adequate capacity would exceed the District's bonding capacity. In an effort to reduce the over-all cost of the project, the District attempted to acquire the water supply facilities originally built by the Defense Plant Corporation for the Basic Magnesium Plant, at Henderson. The old magnesium plant and water facilities had been sold as war surplus to the State of Nevada shortly after the war. Although the District was unable to acquire these water supply facilities, it did acquire surplus capacity rights in the existing system. Shortly after these capacity rights were acquired, the State of Nevada sold the water supply facilities to Basic Management, Inc., which is operated as a private utility supplying water to the City of Henderson and the private industries which now own various parts of the old magnesium plant. Basic Management, Inc. is owned by these private industries.

Bonds in the amount of $8,700,000 were voted by the Water District in 1954. The funds derived from the sale of these bonds were used to purchase the old system from the Las Vegas Land and Water Company, to provide the facilities for importing water from Lake Mead, and to expand and improve the distribution system.

Improvements to Existing System

The BMI system, constructed by the Defense Plant Corporation, had a nominal capacity of 30 mgd and consisted of an intake pumping station, a high lift booster station, a 40-in. pipeline approximately 12-miles long, and a 30-mg terminal reservoir at Henderson. A 69-kv power transmission line and a signal line, each 12-miles long, were constructed as part of the original installation. Fig. 1 shows the elements of this water system and the relative locations of Lake Mead, Henderson, Las Vegas, and intermediate points. This system, together with all power transmission lines for both the water system and the BMI plant, had been designed by J. M. Montgomery & Company, in 1941-42, for the Defense Plant Corp.

In order to fully utilize the BMI water system, investigations were made to determine the maximum quantity of water that could be pumped from Lake Mead through the existing pipeline. After investigating such factors as friction coefficients, pipe wall thicknesses, added friction head, and pump capacities, it was found that a maximum of 50 mgd could be pumped with reasonable efficiency. Under

R. C. KENMIR

R. C. Kenmir attended the University of Southern California. He has spent 30 years in the design and construction of water works and sewage disposal projects. During the past 11 years, he has been in charge of civil engineering work for James M. Montgomery, Consulting Engineer, of Pasadena, California. Such work has included studies, reports, design, and construction of many water supply and sewage disposal projects such as the 66-mgd Alvarado Filtration Plant for the City of San Diego, large covered reservoirs up to 50-mg capacity, and important pipelines and pumping stations for various areas in the southwest. He is a registered civil engineer in California and Nevada, a member of the ASCE, and a member of the AWWA.

PHILIP ABRAMS

Philip Abrams entered the U.S. Army, in 1943, and became Assistant Staff Engineer of the Antiaircraft Command for the Hawaiian Islands. He was discharged as a Captain in the Corps of Engineers. After the war, he attended the University of California, at Berkeley, where he received, in 1949, a B.S. in Civil Engineering. In 1949, he was employed in the Sanitary Engineering Division of the Los Angeles Department of Water and Power. He has been with James M. Montgomery, Consulting Engineer, of Pasadena, California, since 1953. He also is a member of the faculty of the University of Southern California. Philip Abrams is a registered civil engineer in California, an associate member of the ASCE, and a member of the AWWA.

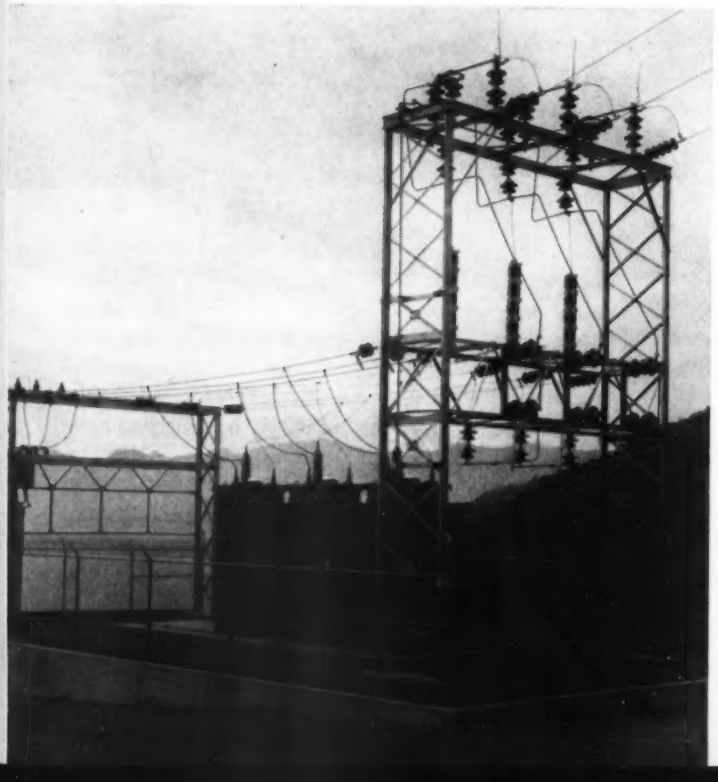
THIS CANTILEVER INTAKE STRUCTURE PERMITS A 179-FT VARIATION IN WATER LEVEL OF LAKE MEAD. THE SUBSTATION, SHOWN IN CLOSE-UP BELOW, IS A PART OF THE NEW PROJECT.

a capacity rights agreement, the Las Vegas Valley Water District acquired capacity rights of 5 mgd until such time as the Water District increased the capacity of the existing system through the construction of additional pumping facilities. Upon increasing the capacity of the system from 30 to 43.75 mgd, the Water District's capacity rights were increased from 5 to 13.75 mgd. The improvements were designed for an initial capacity of 43.75 mgd and an ultimate capacity of 50 mgd.

The general plan for increasing the capacity of the system consists of:

¶ Installing larger pumps at the intake.

¶ Increasing the nominal capacity of Booster Pumping Station No. 1 by reducing the pumping head.



¶ Constructing Booster Pumping Station No. 2, thereby reducing the pumping head at Booster Pumping Station No. 1.

Intake Pumping Station

Since Lake Mead has a possible fluctuation in water level of 179 feet, the design of the Intake Pumping Station, built in 1942, presented a rather unusual problem. Although a vertical shaft located on shore to form a well for the pumps with a horizontal shaft extending out into the lake was a possible solution, it was not used for these reasons:

¶ The lake was near maximum level in 1942.

¶ The rock was badly fractured, and tunneling under a hydrostatic head of 180 feet would have been very slow and hazardous.

¶ The urgency of the war project dictated a design that did not involve uncertainties as to the time of completion.

For these reasons, a cantilever bridge structure, as shown in the photographs, was selected which has a clear projection of 233 feet and extends out over the lake. The deepwell pumps are suspended from the end of the structure.

The original installation consisted of six, 7-stage deepwell turbine pumps with 18-in. O.D. by 182-ft long columns having a combined nominal capacity of 30 mgd when pumping from a lake level at elevation 1050. The motors were 400-hp, 4160-v induction type, housed in a 36 x 36-ft steel building at the outboard end of the bridge structure. All electrical control equipment is housed in a reinforced concrete building located on shore.

The initial improvements include replacement of five of the old 400-hp units with five, new 800-hp units. The old 18-in. O.D. pump columns were removed, sandblasted, repainted, and re-installed.

The old shafting was replaced with larger shafting.

The capacities of the units for various head conditions is tabulated below:

With lake level at elevation 1050
(Assumed minimum lake level)

Pumps Operating	Total Head-Ft.	Capacity gpm	Capacity mgd
1 old	352	3890	5.6
1 new	354	6950	10.0
1 old & 5 new	412	33,700	48.5

With lake level at elevation 1205.4
(Crest of spillway at Hoover Dam)

1 old	197	5350	7.7
1 new	200	8480	12.2
1 old & 5 new	295	43,000	61.8

The original design of the cantilever bridge structure provided for a weight of 69,000 pounds per pump unit, including the weight of the water in the pump column. The actual weights of the old and new units, including water, are 58,000 and 63,000 pounds per unit, respectively. Therefore, no changes in the structure were necessary.

Since the pumps must operate over a range in lake level of 179 feet, it was necessary to use a type of pump especially designed to overcome any tendency toward an upthrust condition when operating with the lake at maximum level.

The original installation was supplied with 4160-v power through a 3-conductor, 300 MCM parkway cable extending from a 69,000/4160-v substation at Booster Pumping Station No. 1 to the Intake Pumping Station, a distance of about 12,000 ft. When the new installation was made, the old cable was retained for emergency purposes, but an independent power supply was provided by building a 69,000-v overhead line from Booster Pumping Station No. 1 to the intake and a 5000-kva steel structure type substation at the intake end of the line. A new incoming line panel was installed in the control building for the new power source, and minor changes were made in the old switchboard. New power leads from the control building to the pumps were installed.

The original pumping station was fully automatic and unattended. Each pump was provided with an in-

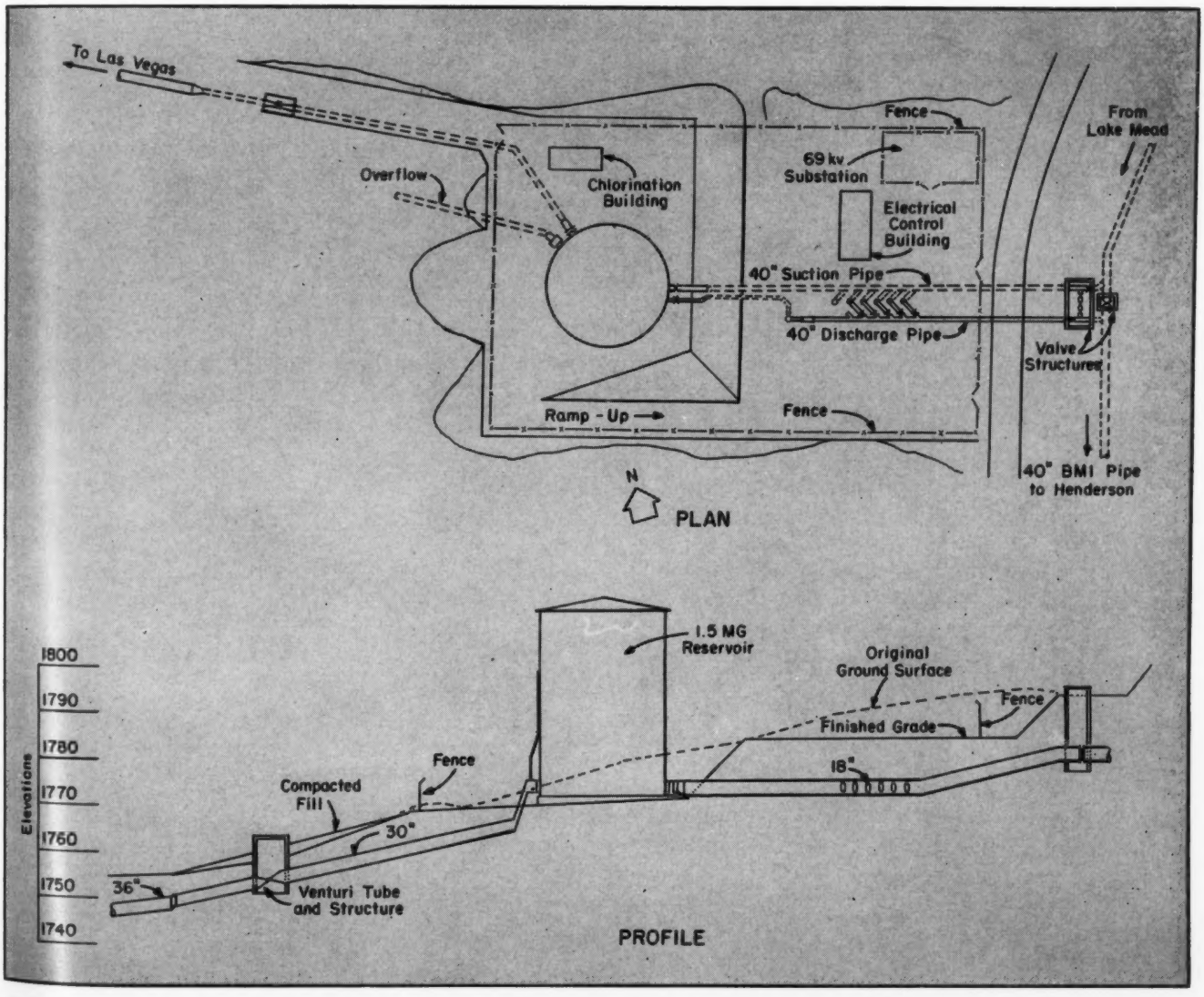


FIG. 2—DETAILS OF THE PHYSICAL LAYOUT OF BOOSTER PUMPING STATION NO. 2 NORTHEAST OF HENDERSON.

BOOSTER STATION NO. 1 WILL HAVE A CAPACITY OF 50 MGD WHEN OPERATED UNDER ITS NEW HEAD CONDITIONS.

dividual float switch located at a float well near the reservoir at Booster Pumping Station No. 1. A multiple-circuit telephone cable is used to transmit the signals between the float switches and the control building. Jacks are provided in the control building for changing the sequence of starting the individual pumps by manual manipulation. No changes have been made in the original automatic control system.

Booster Pumping Station No. 1

The facilities at Booster Pumping Station No. 1 consist of the following:

¶ 1-million gallon cut and fill type reservoir with wood roof; water surface at elevation 1400.

¶ A one-story reinforced concrete pumphouse.

¶ Six, 2-stage horizontal double suction pumps, each unit consisting of two, single-stage pumps connected in series and both driven by a single 1250-hp, 4160-v synchronous motor.

¶ 7500-kva substation transforming from 69,000 to 4160 volts. Prior to construction of additional facilities at the intake, this substation supplied power to both the intake and booster pumps.

An analysis of the existing equipment showed that the total capacity of the station could be increased to approximately 50 mgd by constructing a reservoir at a location convenient for delivery of water to the Water District and having a maximum water surface not to exceed elevation 1826. The site finally selected is on a hillside along the existing 40-in. line about 2.4 miles west of Manganese, Inc., and about 3.9 miles northeast of the terminal reservoir at Henderson.

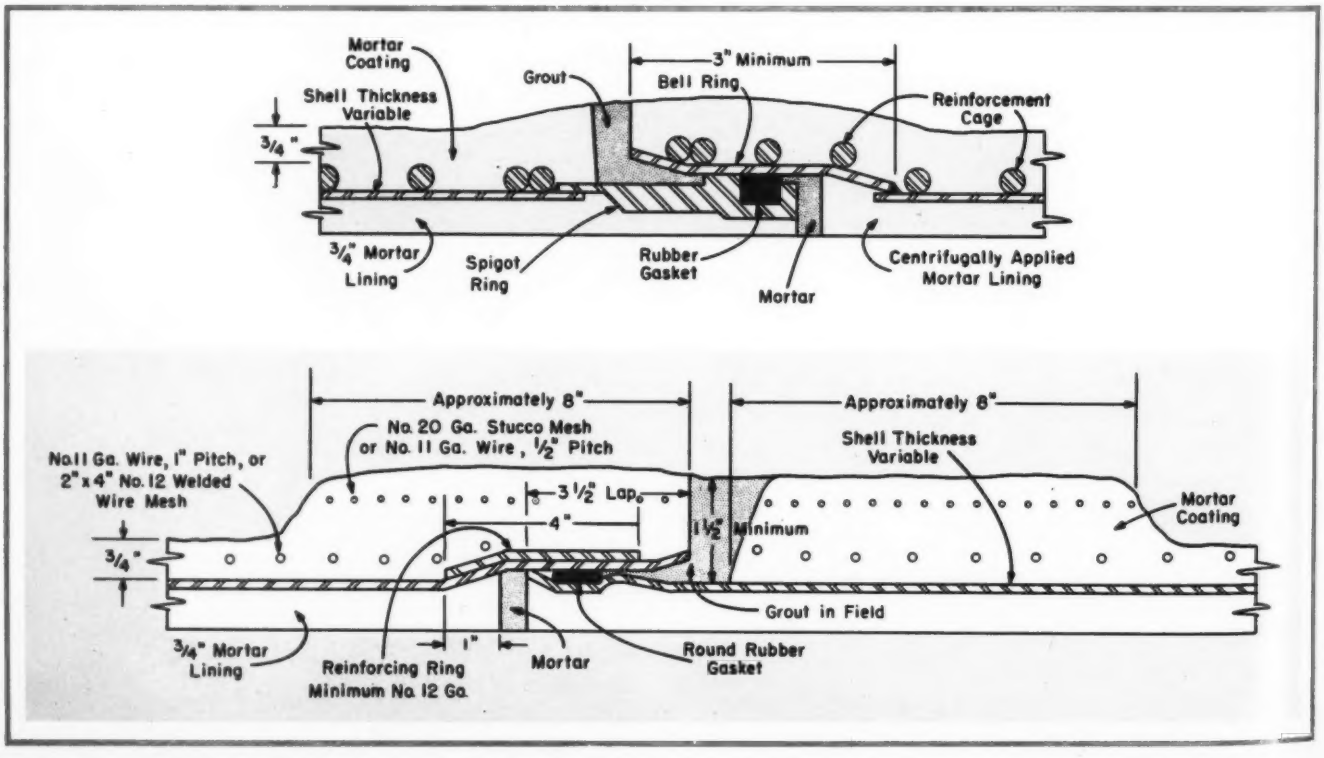
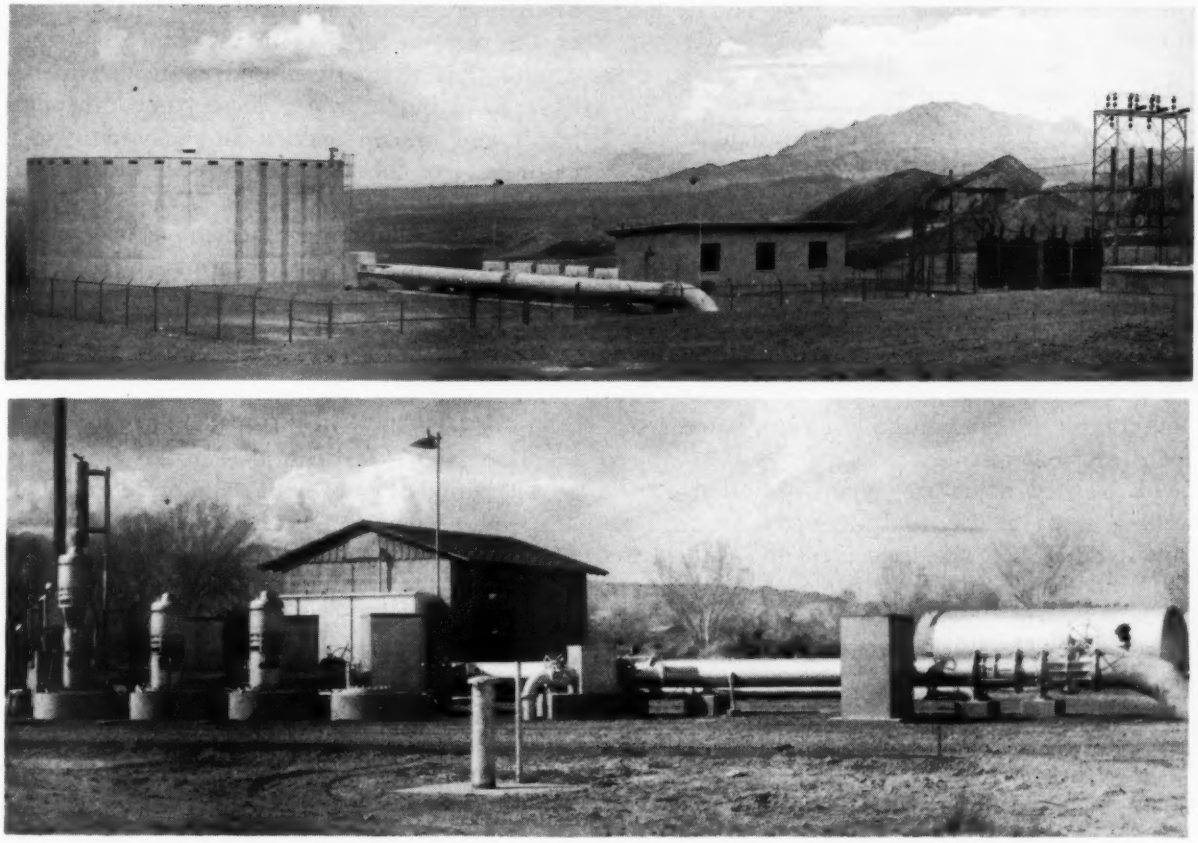


FIG. 3—TOP, TYPICAL JOINT FOR STEEL CYLINDER CONCRETE PIPE. BELOW, MORTAR LINED AND COATED STEEL PIPE.



ABOVE, BOOSTER PUMPING STATION NO. 2 SHOWING RESERVOIR, SWITCHGEAR BUILDING, AND SUBSTATION.
BELOW, BONANZA BOOSTER PUMPING STATION SHOWING ARRANGEMENT OF THE 3 NEW VERTICAL PUMPS.

Overflow in the new reservoir is at elevation 1811.

When the pumps at Booster Pumping Station No. 1 are pumping straight through to the terminal reservoir at Henderson, they operate against heads varying from 650 to 840 feet, depending upon the number of units operating. The capacity per unit under these conditions varies from 5800 to 4100 gpm. When pumping to the new reservoir, they operate against heads varying from 408 to 660 feet. The capacity per unit under these conditions varies from 7300 to 5700 gpm. Under the highest head condition, the station will have a capacity of approximately 50 mgd.

The only changes made at Booster Pumping Station No. 1 consisted of installing a larger venturi meter in the discharge piping and revising the automatic controls. The original controls were semiautomatic with float control provided for only one pump. This required the operator to make frequent trips to the station. Under the new system, the station is fully automatic and unattended except for inspections.

The original installation included a multiple-circuit lead-sheathed overhead telephone cable extending between Booster Pumping Station No. 1 and Henderson. During the past 14 years, boys have used the cable as a target. As a result, the lead sheathing frequently was punctured by bullets. This permitted rain water to enter and short the paper-insulated conductors. The cable was found to be in such poor condition that it was decided to replace the entire 12 miles of line with an 8-pair cable in which each individual conductor is insulated with rubber and the entire group sheathed with synthetic rubber. A puncture in the insulation of this type cable probably would not cause a short circuit. Even with this cable one or more conductors could be served.

Manganese Pumping Station

By constructing Booster Pumping Station No. 2 together with a small suction reservoir in order to lower the head on the pumps at Station No. 1, the hydraulic gradient in the 40-in. pipeline at a point opposite Manganese, Inc. (which is 2.4 miles east of Station No. 2) is lowered by some 275 feet. Under this condition, the Manganese tank, located on a hill south of the pipeline, cannot be filled by gravity. Consequently, a pumping station has been constructed for boosting the water into the tank.

The station consists of three, 100-hp vertical close-coupled turbine pumps using conventional motors. The pumps are housed in a small steel building.

One of the pumps is intended as a standby unit. The combined capacity of two units is about 3.5 mgd, which is considerably in excess of present water demands of the Manganese mine and mill. The pump controls are fully automatic.

Booster Pumping Station No. 2

The facilities at Booster Pumping Station No. 2 consist of the following:

¶ A 1,500,000-gallon steel reservoir, 80 feet in diameter and 40 feet in shell height.

¶ Five, close-coupled vertical turbine submersible pumps with provision for the future installation of a sixth unit. Each pump has a capacity of 4200 gpm against a head of 300 feet. The motors are 400-hp, 2300-v, 3-phase, 60-cycle.

¶ A concrete block control building for housing the electrical controls.

¶ A 2500-kva steel structure type substation for transforming from 69,000 to 2300 volts.

The pumping station site is located on a hillside in deeply eroded terrain. Construction of a shallow earthfill or concrete reservoir on this site would have entailed considerable expense because of the extensive earthwork involved. By using a deep steel reservoir, the 1,500,000-gallons capacity was provided in an 80-ft diameter structure which was built entirely in cut.

Details of the physical layout are shown in Fig. 2. There are two, 40-in. connections to the original 40-in. line with a gate valve between them. The upstream connection serves as a suction manifold for the pumps and an inlet-outlet line to the reservoir so that the reservoir floats on the suction manifold. The pump discharge manifold is connected to the 40-in. pipeline on the downstream side of the valve in the main line. The pumps are set in 30-in. I.D. by 30-ft deep barrels. The inlet to each barrel is valved. Each pump is equipped with a hydraulically operated pump control valve of the spherical plug type, and a lubricated plug valve shutoff. A single 16-in. surge suppressor is connected to the west end of the discharge manifold, which discharges through a separate line to the reservoir.

Submersible pumps were used instead of conventional vertical pumps because the site is located in an area in which high-velocity winds carrying blow sand are prevalent. Comparative estimates showed the submersible pumps would be less expensive than either conventional vertical or horizontal pumps housed in a concrete block building.

Metering and Chlorination Facilities

The Water District is limited by the capacity rights agreement to a withdrawal of 13.75 mg in any 24-hour period. Automatic controls insure compliance by closing a hydraulically-operated butterfly valve located in the 30-in. outlet from the steel reservoir. This outlet is the upstream end of the 17-mile Lake Mead transmission main which delivers Lake Mead water to the Water District's new 30-mg reservoir in the westerly part of Las Vegas. The control is accomplished by means of a counter on the electric receiver of the venturi meter. The counter has normally closed contacts which open after 13.75 mg of water have passed through the meter and remain open until reclosed by a timer at the end of the 24-hour period. The timer resets the counter to zero at the end of the 24-hour period whether the counter contacts have opened or not. The venturi meter is a forward-reverse flow meter which was provided in order to meter water which, in an emergency, can be supplied by gravity from Las Vegas to the reservoir at Booster Pumping Station No. 2.

The chlorination facilities include two automatic solution feed chlorinators, each having a capacity of 400 pounds per 24 hours and a chlorine cylinder scale with capacity for two, 2000-lb cylinders. The chlorinators are controlled from the venturi meter.

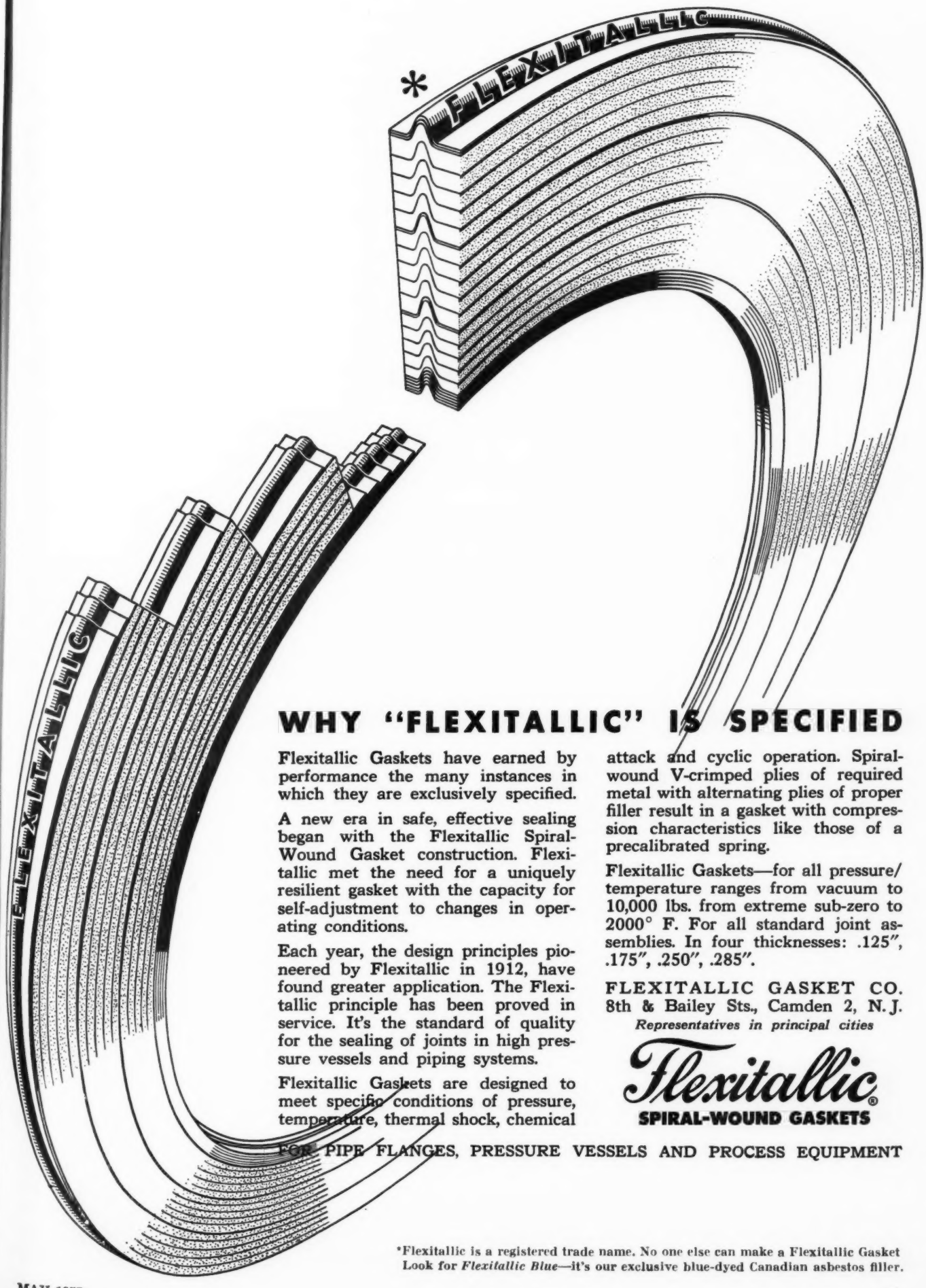
Lake Mead Transmission Main

The Lake Mead transmission main follows an alignment which serves the town of Whitney and the area along the Boulder City Highway and functions as a major feeder supplying the distribution system in downtown Las Vegas. It includes 20 miles of 24 to 39-in. pipeline, and the distribution mains include 27 miles of 6 to 24-in. pipeline.

Pipe materials used in the transmission main consist of steel cylinder concrete pipe and mortar lined and coated steel pipe except for approximately 13,900 linear feet of 36-in. pipe used in the portion of the line just east of Boulder Highway. This portion of the line passes through an industrial waste disposal area operated by BMI. Soil investigations in this area revealed extremely corrosive conditions and for this reason steel pipe was used which was coated on the outside, first with coal tar enamel and then with a ¾-in. thick reinforced mortar coating. The mortar coating placed over the enamel served merely to protect the enamel coating during construction.

Bell and spigot joints utilizing a rubber gasket were used in this section as well as in the balance of the line. The joints were bonded together by placing a 2-in. long fillet weld in the invert between the bell and spigot to permit the use of cathodic protection at some future date. Extreme care was used in coating the joints on the outside. The coating consisted of a ¾-in. thick layer of coal tar enamel which was applied by pouring the enamel in a form consisting of heavy sisalkraft paper. A thinner coating would have been satisfactory, but less labor was involved in applying the enamel by using a thickness equal to the mortar coating.

The steel cylinder concrete pipe consists of a welded steel cylinder with steel Lock-Joint rings attached, a ¾-in. thick mortar lining, steel rod reinforcement



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wrapped spirally under tension around the steel cylinder, and a mortar coating placed over the rod reinforcement to a depth of ¾ of an inch, measured from the outside of the rod reinforcement.

Permanent Pipe Joints

Details of typical joints are shown in Fig. 3. The gasket is a continuous ring of natural rubber having a special composition to assure a watertight and permanent seal. The gasket fills a groove on the spigot ring and forms a seal with the bell ring. Cement mortar or other materials are not depended upon for watertightness.

Mortar-lined and coated steel pipe was fabricated from steel sheet lined with a ¾-in. thick cement mortar and coated with a ¾-in. thick reinforced cement mortar. The coating is reinforced with spirally wound No. 11 gage steel wire spaced at 1-in. centers applied between the first and second coats of mortar.

The mortar lined and enamel-mortar coated steel pipe was fabricated from steel plate having a minimum thickness of 3/16 of an inch. The pipe was lined with ⅜-in. thick cement mortar. After the exterior surfaces were cleaned, primed, and then coated with coal tar enamel, a ¾-in. thick cement mortar coating was applied over the enamel coating. The enamel coating was spark tested for holidays prior to the application of the mortar coating.

The pipeline project was divided into six separate bidding schedules. Bids were taken on the materials separately from the construction but the bids on both materials and construction were received on the same day. The bids were compared on the basis of the over-all cost to the District.

Whitney Pumping Station

The Whitney Pumping Station boosts the water from a point about 2½ miles northwest of the town of Whitney into the portion of the transmission main passing through Las Vegas and terminating at Charleston Heights Reservoir in the westerly part of Las Vegas. The portion of the pipeline from this station back to the 1.5-mg reservoir was designed for 100 psi, and in order to protect it against serious surges upon stopping the pumps, it was necessary to provide a standpipe to float on the suction side of the station with the maximum water level about 10-ft higher than the operating level in the 1.5-mg reservoir at Booster Pumping Station No. 2.

In general, the pumping station is similar to Booster Pumping Station No. 2 in the BMI system.

Charleston Heights Reservoir

The old system in Las Vegas always was plagued with not having sufficient storage to permit 24-hour operation of the well pumps. In order to permit such operation of both well pumps and the BMI pumps, and at the same time provide reserve storage capacity for fire demands and for power outages, which are very frequent during the summer months, a 30-mg reservoir was provided in the well field area located in the westerly part of Las Vegas.

The structure consists of earth embankments, 8½-ft. high reinforced concrete vertical walls, and structural steel roof structure with corrugated aluminum roofing. The bottom and slopes are lined with 3-in. thick open-mix asphaltic concrete.

Improvements to Distribution System

The improvements to the distribution system include the enlargement of three existing booster pumping stations, construction of a 300,000-gallon elevated tank (water surface 155 feet above base), and water mains.

In general, the mains 12 inches and larger in diameter, which will not be tapped for services are either steel cylinder concrete or mortar lined and coated steel pipe, and all other mains are either cast iron or asbestos cement.

The principal construction difficulties were high ground water and the presence of caliche at shallow depths. The latter required blasting in some reaches.

With the construction of these improvements, the pressures throughout the system are excellent. With minor exceptions, the static pressures provided in the upper and lower parts of pressure zones are 45 and 100 psi, respectively.

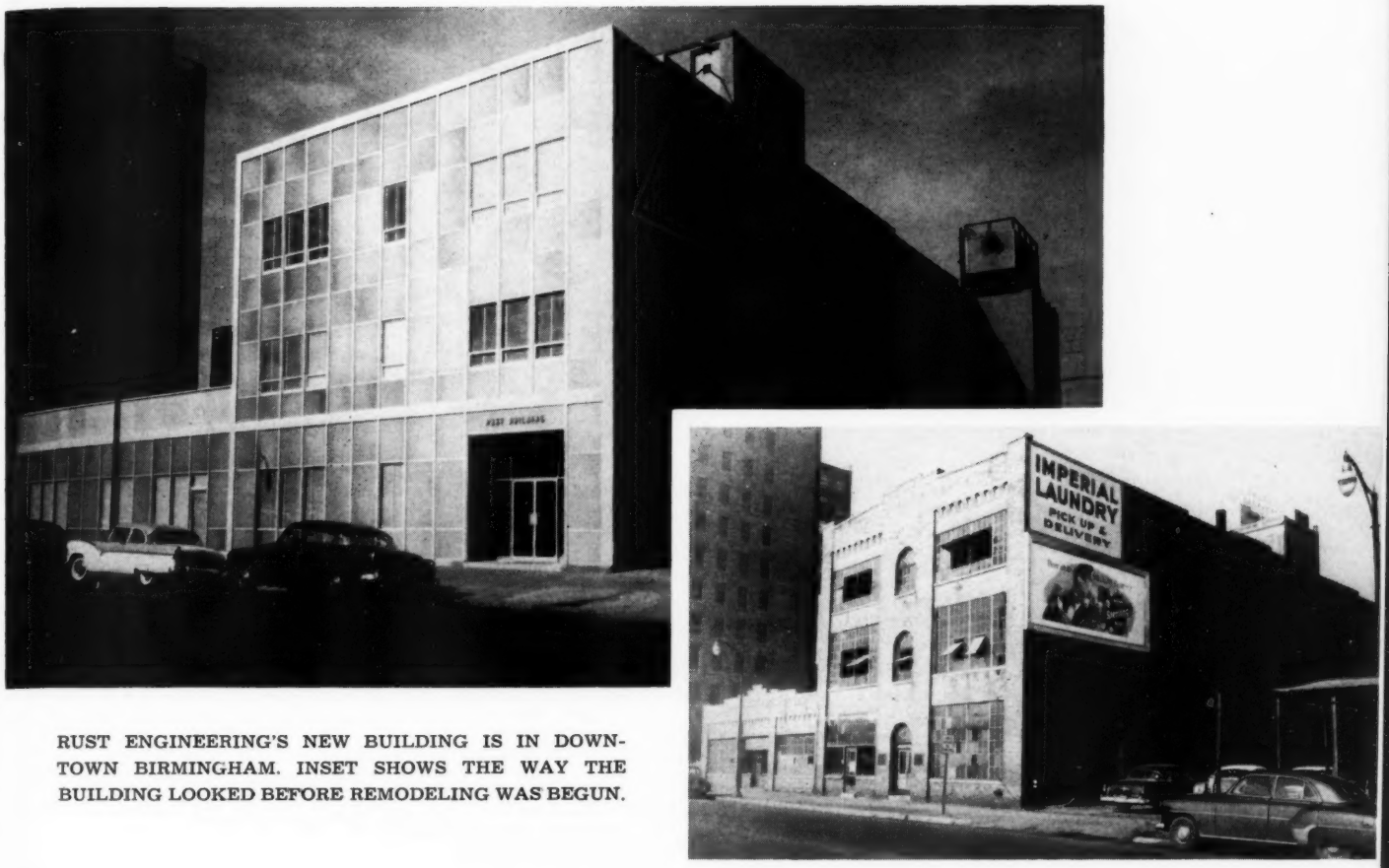
All of the booster pumping stations in the distribution system are provided with standby diesel engines because of the frequent power outages which occur during electrical storms.

Construction Costs

In order to effect all possible savings in the construction program, separate bids were taken on most major items of equipment and materials. Wherever possible, the specifications provided for two or more alternative types of materials. This policy paid off exceedingly well through the very keen competition which was apparent in most of the bids received.

Construction bids on the larger contracts were taken in the fall of 1954 when there was somewhat less construction activity in the area than a little later. As a result, the early bids were much lower than those taken during 1955 when hotel and housing construction in the area was competing actively for all available labor.

Total construction costs were $5,273,000. The project was constructed under the general supervision of William C. Renshaw, chief engineer and general manager of the Las Vegas Valley Water District. Design and construction were under the supervision of R. C. Kenmir, chief engineer for James M. Montgomery, Consulting Engineer, of Pasadena, Calif. Philip Abrams worked on various hydraulic studies and other engineering phases of the project. Harwood L. Jones served as resident engineer for the consulting engineer. ▲▲



RUST ENGINEERING'S NEW BUILDING IS IN DOWNTOWN BIRMINGHAM. INSET SHOWS THE WAY THE BUILDING LOOKED BEFORE REMODELING WAS BEGUN.

We Decided to Stay Downtown

W. B. SPEIR, The Rust Engineering Company

SHOULD AN engineering firm select a downtown location or follow the trend toward the suburbs where space is plentiful — especially parking space? If the downtown location is chosen, should a new structure be built or should an existing one be remodeled? The management of The Rust Engineering Company, of Birmingham, Ala., recently asked these questions and came up with interesting answers.

CE exclusive

After weighing at length the merits of a central as compared to an outlying location, a downtown site was found more desirable for several reasons.

¶ More easily accessible for clients and other visitors, including suppliers' representatives and applicants for engineering positions.

¶ More convenient to transportation facilities, including the Birmingham airport.

¶ More convenient for employees living in various sections of the city.

¶ More convenient to meetings and civic activities in which employees participate during office hours.

¶ More convenient to good eating places and shopping facilities.

Build New or Remodel

The second decision — building a completely new structure or remodeling an existing one — was resolved primarily on the basis of time. A downtown building was found on which a remodeling job could be effected, and it was estimated that this could be accomplished faster than erecting a new structure. Circumstances were such that it was imperative that new quarters be obtained for Rust's engineering department as soon as possible. A one-story section of the building was completed within four months and occupied in July 1956, with the remainder of the building being put into use in October. The management of Rust felt that this was considerably sooner than a new building could be completed.

Economic considerations also were favorable, for the building was remodeled at a savings of approximately $4.00 per square foot over the cost of a new

THIS IS THE ATTRACTIVE LOBBY OF THE OFFICE BUILDING WHICH NOW HOUSES THE SOUTHERN OPERATIONS OF THE RUST ENGINEERING COMPANY. THIS GENERAL MOTIF ALSO IS USED IN ALL OF THE OFFICES IN THE BUILDING.

building. Even with the savings in time and costs, the remodeled building is excellently suited to the needs of an engineering firm. It contains over 30,000 square feet of floor space and accommodates a force of 250. An adjacent parking lot also provides land for future building expansion, as all of Rust's southern operations are housed in these new quarters.

Layout and Utilities

As shown in the photographs, the modern exterior — especially the aluminum, glass, and gray alumilited front — gives the appearance of a completely new building. The drafting room occupies the one-story wing on the left. It will house 150 men, using combination drawing board and desk-type equipment. Optimum lighting intensity of 100 foot-candles is provided over the drafting area by fluorescent drop fixtures. These were selected over the recessed type of fixture to eliminate dark areas on the ceiling and to produce more diffused lighting. This same type of fluorescent fixture also was used in the rest of the building. An emergency lighting system is installed which will provide safety lighting in the event of a power failure.

Music is piped intermittently through speakers which also serve as a public address system. Conference rooms are provided to enable discussions with clients and vendors to take place without interrupting the work of others. There are several emergency fire doors which can be opened only from the inside, transmitting a signal to the switchboard when they are used.

Every effort also was made to secure maximum comfort in the working environment of the personnel. The interior of the three-story structure is bright and modern. Interior walls and partitions are of the movable type so as to provide flexibility if changes are needed in the future. All ceilings have acoustical material installed. Floors are asphalt tile. The top floor contains offices for the executives and project managers. The second floor houses the estimating department, purchasing department, project engineers, a large conference room, and the industrial planning department. The first floor has an attractive lobby for receiving visitors. A coffee room containing automatic vending machines takes care of the coffee breaks so that employees do not have to leave the building. The elevator is of the automatic type, designed to outguess the interfloor commuters so that less time will be lost in waiting.

Communications

Since most of the projects handled by this office are scattered over the South, communication plays an important part in the daily operations. The most advanced systems are required to handle traffic. This includes two telephone switchboards, a teletypewriter, and a telegraph Desk-Fax. Of special interest is the Dictaphone system that is interconnected with the telephone system and enables anyone to dictate correspondence merely by picking up the telephone and dialing this service. When originally installed in Rust's previous office, this was the first system of its kind in the South.

There also is a reproduction section containing two, Bruning copyflex, white printers with a print capacity of 200,000 to 300,000 square feet of prints per month. The mail room is adjacent to this reproduction section and contains the latest automatic mailing devices. A mail chute connects all floors with this room.

Another interesting feature is the heating and

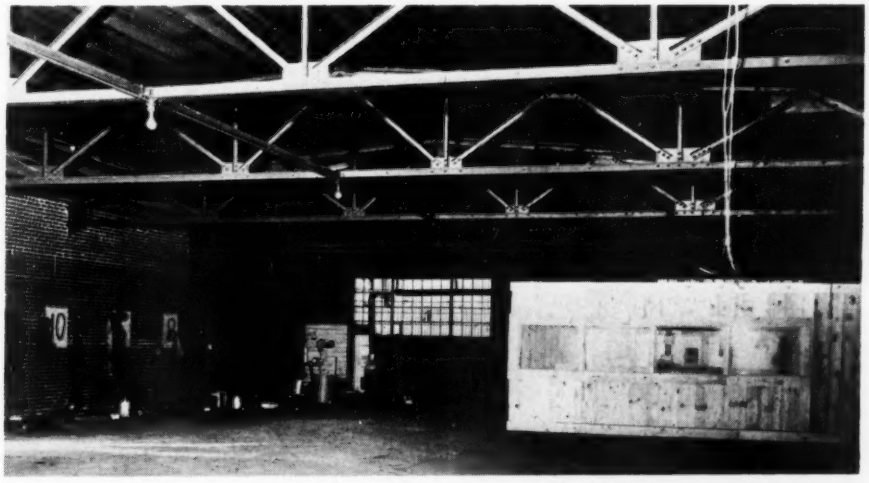
air conditioning system—one of the most unusual in this area. A year-round, automatically controlled, air conditioning system was custom designed to provide uniform comfort conditions throughout the building. Temperature is held between 74 and 75 F, regardless of the outside weather conditions. A central station, multicompressor, water chiller system supplies circulating cooling water to each of four, multizone, cabinet type air conditioning units. To assure proper humidity control, the temperature of conditioned air is cooled to 58½ F to extract excessive moisture, and it then is reheated on demand of zone thermostats to maintain the desired temperature in the building.

Control Systems

Humidity and temperature are held to close tolerances by a pneumatically operated control system. In order to offset the heating effects of the high intensity lighting system, the refrigerating cycle of the system was designed to operate even when the weather is below freezing. Anticipating future expansion, the design was made on the basis of 165 tons, with 90 tons presently installed.

Since Rust operates as a service organization, efficiency and speed are essential. This building was designed to serve as a production tool toward this efficiency and speed. The project manager group on the third floor relays information to the drafting room through the project engineer group and the purchasing and estimating departments on the second floor. The drafting room produces the data for construction, which is released to the field through the project manager group. In order to attain maximum efficiency in the drafting room, it was decided to have all sections in one large room, thus minimizing the communication problem. Design was for a 150-man room, which is presently filled.

After several months of occupancy, the management of The Rust Engineering Company feels that this new building is contributing materially to improved efficiency and lower costs. ▲▲



RIGHT, A VIEW OF THE SINGLE-STORY ANNEX BEFORE REMODELING. BELOW, SAME AREA REMODELED AS A DRAFTING ROOM WITH SUFFICIENT WORKING SPACE FOR A COMPLEMENT OF 150 DRAFTSMEN.

MECHANIZATION, AS EMPLOYED HERE IN A GROCERY WAREHOUSE, HAS RESULTED IN SAVINGS OF UP TO 80 PERCENT.

New Directions in Warehouse Design

WILLIAM H. MESEROLE, President
Ballinger-Meserole Company
Warehouse and Distribution Consultants

William H. Meserole, president of Ballinger-Meserole Company, industrial and distributive space and methods consultants, in Philadelphia, was educated in the National Academy of Design, 1911-14, and Societe' des Beau Arts, 1914-17 (Medallist 2nd Class, 1917). He enlisted in the U.S. Army during the First World War, and joined the American Relief Administration in 1918, serving as a statistician until 1925, and as an economist until 1928. He then joined the Marketing and Distribution Division of the U.S. Department of Commerce, where he served until 1945. Meserole moved into private practice that year, joining Ballinger Associates as chief engineer. He became president in 1952.

PUSH A BUTTON and incoming goods are moved swiftly and surely through a warehouse where no operator ever sets foot. Materials are received, organized, and stored so that when other buttons are pushed, shipments are delivered and stacked automatically in trucks. Except for pushing the buttons, man has no place in this truly automated warehouse.

Unfortunately, that warehouse does not exist, and current notions to the contrary, it may never exist except in isolated and exceptional instances.

Probably a computer could be designed that would handle the appropriate operating information needed for running an automated warehouse, but it is not likely that such a computer would be economical. It must be recognized that automation is economically applicable to some but not to all types of operations. The more variable the operations, the less practical automation becomes—and distribution warehousing is a complex combination of varied operations.

Before discussing automation and mechanization, it is necessary to agree on a definition. We think of automation as the electro-mechanical performance of an operation or a group of operations in such a way that the process is completed without human

brains or hands. This involves not only the performing of production operations but the controlling of those operations

Mechanization involves the use of machines to do repetitive production jobs, but the machines are controlled, set, and adjusted by men. Men are in control, not electronic "brains" or computers.

Divide and Conquer

Automated production is the latest in a series of developments in production methods. Adam Smith, in his *Wealth of Nations*, published in 1776, explained how production could be increased in the manufacture of pins if workers were assigned to simple repetitive tasks rather than having each worker carry the whole process through from start to finish. For example, one man making pins might produce 10 pins a day. Ten men, working separately, then would be able to make 100 pins a day. But if each of these men were assigned a particular task—one cutting stock to length, one making points, another forming heads — these 10 men could produce 50,000 pins a day. This is called the principle of the division of labor.

Later, the concept of the production line was applied, accomplishing an even greater output per man-hour, and then mechanization—with the most repetitive tasks being taken over by machines, but with men controlling the machines. Automation goes even further and makes possible automatic control—and correction of errors—by electronic, electrical, and mechanical devices.

The principle involved in Smith's concept is constant increase of production through the breaking down of operations into simple, routine, repetitive tasks. It is essential that these operations repeat precisely time after time.

This repetition is the key to the success of the production line, mechanization of operation, and automation.

The most efficient factory production makes use of automatic equipment grinding out large quantities of identical products. Miles of wire can be put through a screw machine, and the machine will turn out screws until it runs out of wire or someone turns it off. Size and shape of product can be changed, but only by changing the dies and resetting the machine. If we wanted to produce screws in every size increment from ½ to 4 inches; if we wanted roundhead, flathead, and recessed flathead varieties; and if we wanted them of steel, brass, and aluminum, then we would begin to face a problem in efficient production. If we went further and decided we must have both slot and hexhead, and we want these screws packaged in three different types of boxes and two sizes of cases, we would be faced with 2610 options. Also assume that we do not know from one day to the next which wire, boxes, and cases will be available. We cannot predict either the volume or type of production that will be required, and we face unpredictable peaks hourly, daily, monthly, and seasonally.

Under these conditions, our automatic screw machine becomes inefficient. Simpler, less-automatic machines, would be more practical—machines that permitted quicker change from one type of product to another. Again we have a demonstration of the principle that machines can replace men in performing repetitive tasks, but they can only supplement in performing work that involves variety.

AUTOMATION, IN FORM OF COMPUTERS, ALREADY HAS INVADED THIS GROCERY WAREHOUSE CONTROL ROOM.

One Line, One Product

This application of Adam Smith's division of labor, and the further development of the production line, results in what may be termed seriatim production—the finished products come off any line or out of any machine one at a time. One by one the products come off the assembly line or one by one the screws come out of the automatic screw machines—all alike until the settings are changed.

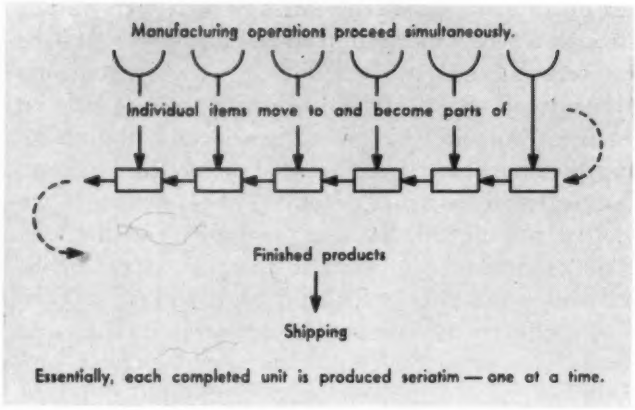
Contrast this with the composition room of a print shop. Here many men are working simultaneously on the same book, setting type and arranging it in page form, but each man is working on a different page of type. Since every page is different, mechanization is impractical. There is no repetition.

In this composing room we have simultaneity as the principle. Ten men are working, putting together type for different pages, and all these pages of type can be completed at the end of the same day —they are worked on and finished simultaneously.

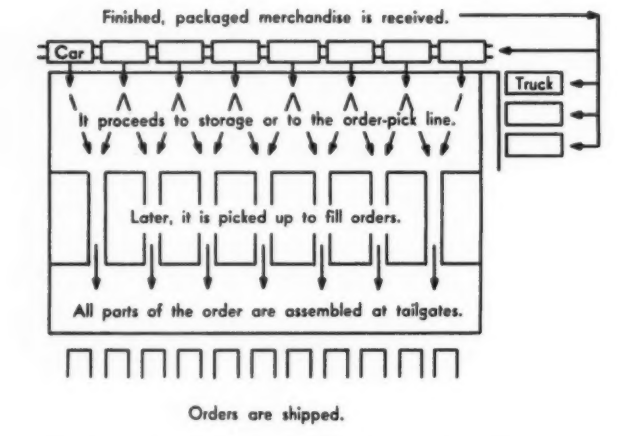
Only when the type gets to the press does automatic machinery come into use in repetitiously producing thousands of impressions from the same type. In the press room, the printed sheets come off the press one at a time, seriatim.

Automation or Simultaneity?

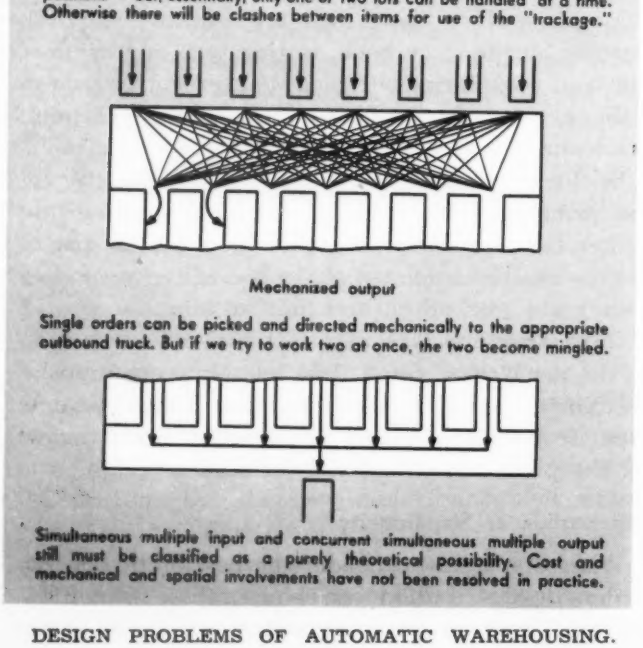
When one starts to ponder the possibilities of the automatic distribution warehouse, these principles must be kept in mind. Does the activity of such


Manufacturing operations proceed simultaneously.
Individual items move to and become parts of
Finished products
Shipping
Essentially, each completed unit is produced seriatim — one at a time.

DESIGN PRINCIPLE OF FACTORY PRODUCTION LINE.


Finished, packaged merchandise is received.
Car
Truck
It proceeds to storage or to the order-pick line.
Later, it is picked up to fill orders.
All parts of the order are assembled at tailgates.
Orders are shipped.
Note that by assigning more or less manpower to either input or output, according to the need, shipments from many suppliers and order-picking for many customers can be handled simultaneously — and also continuously.

DESIGN PRINCIPLE OF DISTRIBUTION WAREHOUSE.


Specific functions or operations can be mechanized.
Mechanized input
Goods can be moved mechanically from the receiving stations to warehouse positions — but, essentially, only one or two lots can be handled at a time. Otherwise there will be clashes between items for use of the "trackage."
Mechanized output
Single orders can be picked and directed mechanically to the appropriate outbound truck. But if we try to work two at once, the two become mingled.
Simultaneous multiple input and concurrent simultaneous multiple output still must be classified as a purely theoretical possibility. Cost and mechanical and spatial involvements have not been resolved in practice.

DESIGN PROBLEMS OF AUTOMATIC WAREHOUSING.

warehousing adapt itself best to automatic or automated production techniques with seriatim operation, or does it function most efficiently with a simultaneous system?

In the modern warehouse, goods are received, sorted, and stored simultaneously by any number of men, and the selection of orders for shipment is handled simultaneously by another group, both groups working at the same time. The number of men on either job can be changed from hour to hour, day to day, in accordance with the varying work load. The principles of simultaneity and matching the labor force to the work load are applied.

Yet, it may be presumptuous to say that since warehousing involves variety, it is impossible to adapt the principles of automation. Perhaps it will become practical; but look at the limitations.

No single machine can produce orders simultaneously any more than one man can, for if more than one order were picked at any one time by the same machine, orders would become mixed and chaos would result on the shipping platform. A machine simply cannot adapt to simultaneous operations.

Too Much for Too Little

If orders were produced seriatim by one installation of machinery, the operation might be smooth, but the output would be low. It would be impossible to justify the high cost of such a complicated machine for such a low output. For example, a grocery firm with sales of $60 million per year might employ 100 men in its warehouse. Of these, about a third would be order pickers. At 180 pieces per man-hour, the 33 pickers would produce 47,520 pieces per day for 250 working days — or about 12 million pieces a year. If each piece has an approximate value of $5, we arrive at an annual sales volume of $60 million.

In response to any momentary need, the force of order pickers could be increased so that the trucks could roll earlier — or reduced if the task of the specific day were smaller. To duplicate this volume of 47,520 pieces per 8-hour day, a machine would have to produce nearly 6000 items per hour, 100 pieces per minute, or 1.67 pieces per second. Such an output would be necessary for every second of the 8-hour day if the machine were to produce the orders one at a time. And we could not speed up this machine to roll the trucks earlier. Moreover, any break in the continuity of flow would extend the work day correspondingly.

Even if we operated the automatic warehouse 24 hours a day, for 250 days per year, we would have to produce 2000 pieces per hour, or 33 per minute — more than one piece every two seconds — in an unbroken cadence.

It is true that a machine might be able to pick a number of items simultaneously while the completed orders came out one at a time. This would be

comparable to a seriatim assembly line fed simultaneously by subassemblies. Then, assuming that the average order was for 10 items, with two, 4-hour operations, we still would have less than 20 seconds to produce each order. In this 20 seconds, all pieces in the order would have to be moved from the slots and be carried out to the platform. Even if we assume that the goods could stand being moved so fast, we still would have no excess capacity for peak loads. To get out the necessary volume the machine would have to produce an order of 10 pieces every 20 seconds, 24 hours a day, 250 days a year. Neither inbound nor outbound goods are adaptable to such even flow. A second machine would not fit in the same warehouse, so the only solution to needed expansion or peaking would be to build a second plant, with a second inventory.

Save Walking Time

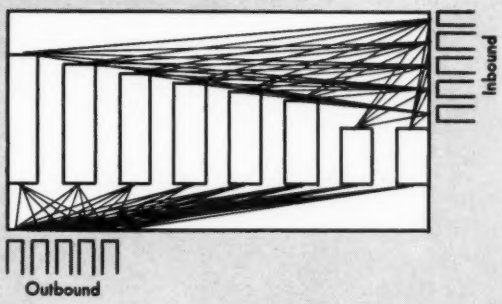
Inertia will prevent a machine from removing a carton from a rack very much faster than a man can do it. Accordingly, a machine might save only the time that the order pickers spend in unproductive walking. But let us assume that a machine can get a case out of a rack three times as fast as a man. How long would it take to pick the order?

An order-picker spends roughly 40 percent of his time picking orders and marking his sheet. The remaining 60 percent is time wasted in walking. His output is roughly 180 pieces per hour. Presumably, therefore, if a machine can pull a case out of a slot as fast as a man, it will produce 180 pieces in 24 minutes. Assuming that the machine can move a case from a slot three times as fast as man — a figure that would appear to be about the maximum limit — the output will be 1350 pieces per hour. If the machine can produce all cases for a given order simultaneously and if the average order is 10 pieces, the machine, then, theoretically can move 13,500 pieces per hour from the slots.

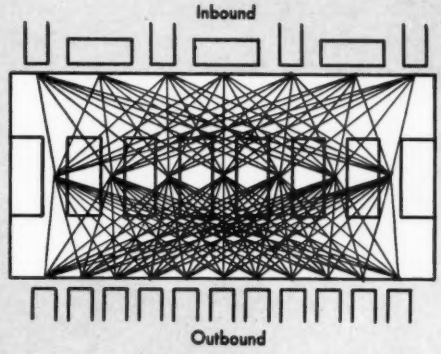
Still in the Warehouse

But this is not getting the goods out of the warehouse. Let us examine the transportation time.

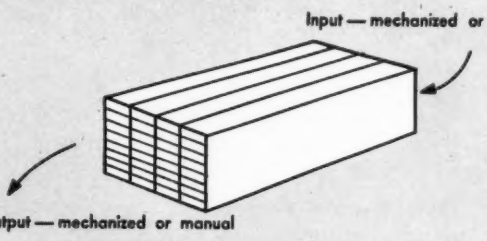
The time needed to transport an order to the shipping platform will be the time needed to transport the item that is most distant, because a new order cannot be activated until all previous orders have cleared the warehouse. If we have a warehouse of 100,000 square feet, e.g., 1000-ft long x 100-ft deep, the maximum distance a given case would need to be moved would be 1100 feet. Let us assume that this maximum distance for the average order is 1000 feet and that we move the cases at an average speed of 10 feet per second. (Possibly at some points cases could be moved faster than this but it is unlikely that the average speed can be higher.) We then shall require 100 seconds to move each order from the racks to the shipping platform. This



For only a dozen or so fast movers handled mechanically — a beverage distributor, for example — complete automation may be feasible at present.

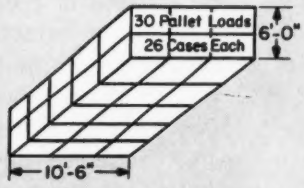


But there will be hopeless "trackage" difficulties in connecting 5000 or more goods stations to all inbound and outbound points simultaneously and on a multiple basis. To illustrate, examine the following warehouse layout.

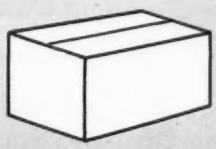


Assume this warehouse's inventory includes 5000 items. One item requires a stock of 10,000 cases; for another, 10 cases last 4 months. Among the balance any nuance of count occurs, yet input and output still must be seriatim.

If each tier is 8 slots high and each slot is 2' wide, and if each case is 1' deep, 800 cases can be stored on a floor area 2' x 100' (200 sq ft). But with pallets and lift trucks, in a height equal to that of the mechanized tiers, 780 cases only occupy an area of 6' x 10½' (63 sq ft), as shown below.



Even if all the above factors could be resolved, a real problem remains. We have to repeal the law of inertia. Consider the average case of groceries.



This case is strong and durable; it weighs 30 lbs. How fast can a machine seize it and move it to the shipping platform without tearing it apart or mashing it against other outbound goods? Say 3 times as fast as a man for grasping and say we hurl the cases along a conveyor at 40 fps. This is not fast enough since orders, even if automated, still must be handled seriatim.

Question: What would you recommend to a client faced with these problems?

DESIGN CONCEPTS FOR SIMULTANEOUS MULTIPLE PERFORMANCE OF ALL WAREHOUSING FUNCTIONS.

will give us 36 orders — 360 pieces — per hour. Working 24 hours a day and discounting the time required to pull the cases from the slots, we get out only 8640 cases. This compares with the 47,520 cases per day that we need to maintain our volume — the quantity produced by 33 order pickers in the average 8-hour day.

The order pickers, working simultaneously, produce an order every 5½ seconds. Even on a 24 hour basis we need an order every 16 seconds. Yet it appears the best that the machine can be expected to do under the conditions described is an order every 100 seconds. So we are not limited primarily by the speed with which a case can be pulled from a slot, but rather by the speed with which inertia permits us to move the case to the shipping platform.

The speed of the entire machine, of necessity, will be limited to the speed with which the most fragile item can be moved. If we exceed this speed and lose even a single case, we shall be in trouble because an automatic warehouse can have no provision for men to be moving about to pick up broken cases and correct other errors.

Even to approximate the speeds necessary for this seriatim production, we shall have cases hurling about the warehouse at such velocities that the floor soon will be covered with rubbish that was merchandise a few moments before.

Inconceivable Variety

Nor is speed or volume the only problem. There is also variety. With 4000 items, any one item, in any quantity, may be associated with any other item or any combination of items, each in any quantity. The possible combinations of these items would be represented by a number so totally inconceivable that even if possible to express on an electronic computer, is obviously beyond mechanical solution. Yet this is the output task only, which must be coordinated in ultimate detail with the task of receiving and storing the 4000 items, none of which is necessarily treated exactly alike. Any machine must be designed for a capacity, and so must this one. Even ruling out 99 percent of the possible permutations as improbable, the capacity required for the remaining one percent suggests the astronomical equation which would have to be solved before an attempt were made to design for complete automation in any warehouse of this capacity.

Let us assume for the moment that someone will develop a totally new concept that will permit the construction of some fantastic equipment to grind out orders with some degree of simultaneity. This would solve the problem of volume. Let us examine some of the other problems that would have to be solved before an automatic warehouse could become a reality.

One important problem is the need for flexibility. Product diversification; changes in the size, style, and shape of packages; shifts in the sales geography; and substantial changes in the nature and behavior of individual items will penalize the distributor who cannot adjust.

Too Much or Too Little

For these reasons, capital investment must be written off quickly to permit the purchase of better equipment. A prudent man would figure little more than 3½ years for the payoff of materials handling equipment if he is to amortize it in 10 years. He cannot afford to keep two men if one man and a machine can do the same work. Yet automation, by its very nature, is inflexible. It would have to be engineered for the maximum peak load possible in the foreseeable future. This means that the user would pay for much more capacity than needed at any other moment. But without this extra built-in capacity, input and output will fall behind during the unexpected peaks. There will be no provision for increased volume, and the mechanism will have to be scrapped or duplicated.

In normal warehouse operation, the superintendent knows each morning how many orders he has. He knows how long it takes to pick the volume needed, so he readily can calculate the number of men needed that day on the line. The rest of the men are assigned to other duties. When business drops off, or increases, it is a simple matter to adjust the warehouse force. This mechanical-manual system is kept flexible by using many units (men with machines) instead of a single unit. The owner pays only for the work actually accomplished, and his capital is not tied up in excessive potential.

No "Average" Warehouse

Warehousing varies so greatly from one industry to another that it is not possible to construct an over-all hypothetical example of automation replacing mechanization. However, let us assume that a distributor handles 10 basic units, each in 4 colors, 12 lengths, and 7 widths. He has, then, 3360 separate options with which to deal. Each item must have a slot where it can be stored; extra slots must be available for the fast movers that require more space; and there must be more extra slots for spare parts, new items, and incoming goods. Four thousand slots would not be too many for this number of options. (Each new basic unit adds 336 new options.)

Our distributor has a $5 million a year business and requires 10 men at $5000 a year each to operate the warehouse. Their total salaries are $50,000, or one percent of sales. At $7 a foot, his 50,000-ft warehouse would cost $350,000. Standard mechanical equipment, at $1 a foot, would cost $50,000 to be amortized in 10 years. Thus, total capital investment would be $400,000, of which $350,000 is to be written off over 20 years. Utilities, insurance, and

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taxes could amount to $12,500 per year. Annual operating costs, therefore, are as follows:

Amortization & Interest	$ 35,000
Depreciation of Mechanization	5,000
Operators' Wages	50,000
Service Charges	12,500
Total Yearly Operating Cost	$ 102,500

If we now proceed to automate the warehouse we shall save some of these costs. Let us assume that we shall need only one man for maintenance and one operator, and if we operate at the most efficient level, 24 hours a day, we shall have three operator shifts. Accordingly, we need four men rather than 10, a saving of $30,000 or 60 percent of the annual $50,000 labor cost. In addition, we shall save a part of the annual $12,500 service charges, as lights will not be required, and less heat will be needed, etc. On the other hand, the automatic machinery will require power of some sort, so the net annual savings on other than labor will not be large, perhaps $2500. This would give a total saving of $32,500 in yearly expenses.

Automation Marches On

Assuming that all of the new electronic gear and the rest of the machinery can be stuffed into the existing building, most of the $32,500 a year will be available for purchase of the automatic equipment itself — not all of it because the new equipment must itself be amortized. But discounting this, we can spend no more than 3½ times the annual savings, and so our equipment can cost up to $113,750. It is not safe to write off the equipment over a longer period because it soon may be outmoded. The owner, therefore, must be able to buy all of the new equipment at approximately $2.27 a foot as against the cost of the $1 per foot now spent for mechanical equipment. The new equipment will include not only the electronic gear, but also new materials handling equipment, since all the original equipment that cost $50,000 must be scrapped. Assuming that the new automatic materials handling equipment costs no more than the old mechanized equipment — an unlikely assumption — we shall have only $63,750 total, or $1.27 per foot, to pay for electronics.

In all this we have concentrated on outgoing orders. But we must be able to receive just as fast as we ship, and this input will involve a wholly independent system that feeds but must not interfere with the gear handling the output.

Progress at a Price

Generally speaking, the cost of automation in a warehouse will increase in more than arithmetic progression with the increase in the number of items to be handled. Automatic equipment to process 40 items is conceivable, where large volumes are involved. When 4000 items are to be handled, the cost would be astronomical.

The wise user of automatic equipment will insist on safety and reliability of operation. There must be access to every hinge, switch, and wire. Provision will have to be made for putting the warehouse out of operation, at least in part, for occasional repair.

It is horrible to imagine what damage a fire, smoke, or water could cause. And if a small fire or some other accident put the warehouse out of commission, the distributor will find himself out of business, because without provision for the application of manpower he could make no provision for getting out his orders.

Partial Automation?

If the automated warehouse seems impractical, what about a partially automated warehouse? In any warehouse, about 20 percent of the items accounts for 80 percent of the volume. Would it be feasible to automate the fast movers only? Or is it the slow movers that should be automated?

Presently we are stacking goods 20-ft high, a limit fixed by the near-maximum lift of modern high-lift trucks. Doubtless the machinery for automatic handling of high-stacked goods would be more costly than the machinery for handling merchandise stored on only one level. However, storing goods on one level would increase distances and involve a much larger warehouse and more land. Would the saving in the cost of machinery offset the extra cost of a larger warehouse?

Many such questions must be answered before even the partially-automatic warehouse can become a reality. Meanwhile, we can offer the prospective owner a high degree of mechanization. In addition, we can offer him the dependability, safety, and flexibility that he needs to get out the merchandise in sufficient volume, at the right time, and at minimum cost.

Personally, I would like nothing better than to see a push-button warehouse. Indeed, we are at present enthusiastically designing for automated distribution of a few dozen different items. Possible cost problems are the only impediment here to the construction of the warehouse and equipment.

But for the full and successful operation of an automated warehouse with a wide inventory, I know of no equipment available. Until such machines are developed, we must continue to mechanize to the greatest possible degree.

We have today an extremely wide opportunity for application of mechanization to warehousing. Unless automation can do what mechanization can do, and do it at a lower cost, and at high enough speed, no distributor is going to buy it.

We must not ignore the possibilities for proper application of automation, but we cannot expect it to do work for which it is not suited. ▲▲

. . Architects, Engineers and Contractors prefer ALLENCO

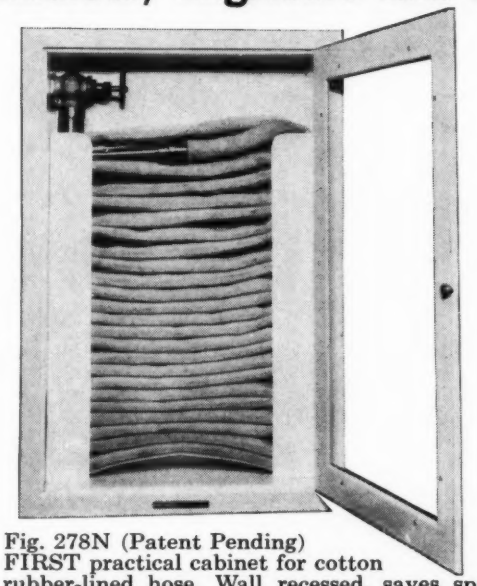

Fig. 278N (Patent Pending)
FIRST practical cabinet for cotton rubber-lined hose. Wall recessed, saves space; fully enclosed, resists attack by fumes, dust, etc. Cradles hose in soft folds, ready for instant use. Several models, sizes and hose-lengths.

Fig. 7153 (listed and approved by Associated Factory Mutual Insurance Companies)—UNIQUE form of major fire hose cabinet, ideal for smaller structures. Steel cabinet no bigger than phonograph record album holds 30-40-50-75 feet of fire type hose. Recessed or wall hung.

Of the many distinct ALLENCO products and models, these are most widely specified and installed in the industrial field

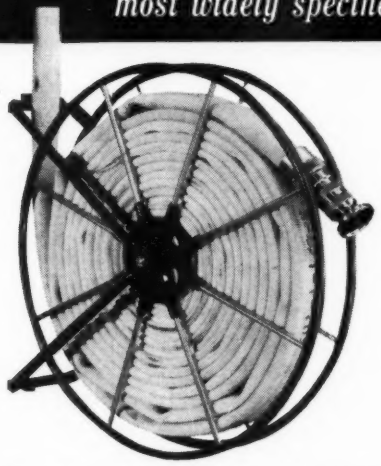

Fig. 145 (UL and FM listed and approved)—Ryerson swinging hose reel with wall brackets or pipe clamps. Holds 50-100-150 feet of cotton rubber-lined hose out of way, yet swings and feeds instantly. To suit type, size and length of hose required.

Fig. 7170 (Patent Pending)—"Hozegard" reel combines protection with fastest way to get full pressure at nozzle in use. Best for linen or light-weight CRL hose, 50-75-100 feet in length, up to 1½" size. Adds years to hose life, fights fire faster.

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It is Time to Start Seeking

A More Logical Fee Formula

RALPH M. WESTCOTT

CE exclusive

THE CONSULTING ENGINEER has no business problem so formidable as that of establishing some reasonable and generally accepted formula for the determination of fees. During the past 20 years considerable thought has been given to the calculation of fee schedules by a number of engineering societies. The American Society of Civil Engineers publishes a schedule of recommended minimum fees, as do several of the state societies of professional engineers. The American Society of Mechanical Engineers recently completed a median fee schedule, and no doubt there are yet other fee schedules available.

While all of these fee schedules mention per diem fees, cost plus fees, and retainer fees, the real emphasis always is given to fees based upon a percentage of construction costs.

Over the years it has become customary to bill architectural and engineering fees on the basis of a percentage of construction cost. This practice has become so common that most engineers are inclined to think that usage has proved it proper. Yet, the fact is that this fee formula is illogical and contradictory. We all know that percentage fees have little logical relation to the work done. We sit in our councils and agree to a certain minimum percentage fee for engineering services, but we do not relate this percentage to ethical practice, the factual requirements of the job, or, in fact, to any fundamental standards of performance. It is true attempts are made to define a degree of complexity for the project, as 5 percent for minimum, 6 percent for average, and 7 percent for maximum. This simply defines the type of construction, not the quality nor necessarily the extent of the engineer's service to be provided. An engineer doing nothing but the minimum design work, the least possible detail, and the most careless construction supervision receives the same percentage fee as the en-

gineer doing the best design, with every detail complete, and the most careful supervision.

Minimum-Maximum Schedules

Most of these schedules are called "minimum" fee schedules, but in practice, they tend to become "general" or even "maximum" fee schedules, applicable alike to good and bad work.

Because of this, the responsible engineer, the ethical engineer is hurt, for the fee is insufficient to cover his costs. The irresponsible engineer can make a good profit, for he skimps on design time, leaving details to the contractor to work out and add to his bill, or he makes use of design services offered "free" by manufacturers in return for specifying their products. There is an obvious inequity when both types of engineering are paid for on the same basis.

The inequities of any fee system go deeper than the financial welfare of the engineer himself. They carry through to the detriment of the client.

Faults of the Percentage Fee

Under a percentage fee system, the more a particular project costs, the more money the engineer makes. The more conscientious the engineer, the wiser and the more expert he is, the lower his fee. If the engineer, through superior design and complete detail, is able to cut the construction cost and save his client money, he is penalized by a reduction of his fee. How silly a method when the ratio of costs to the client is about 10 or 20 to 1 for construction over engineering. Wouldn't you spend $10 to save $90?

The engineer has every incentive to design the most costly and wasteful project possible. It is only professional pride and ethics that cause him to do the best job possible regardless of the effect on his fee. Every instinct for economic survival contradicts his actions. This is a level of ethical action to be expected only from saints and angels and eleemosynary institutions. It is fundamentally wrong to operate under a system that pits ethics against reward. Instead, they should go together. In other fields it is customary to reward rather than penalize the man who saves you money.

Attorney's Fees

Look at the practice of the legal profession. If you engage an attorney to sue someone who has wronged you, it is likely that his fee will be based upon the size of the judgment awarded you by the court. If you win your case and are awarded $5000, the lawyer might receive $1000. But if your lawyer is successful in having the court award you more, perhaps $10,000, then his fee goes up. He is rewarded for getting more money for you. The better job he does, the more he is paid. If he were paid in the same way as the engineer, the more you received, the less you would pay him in fees. Now, lawyers are members of a profession, and they have a well regarded code of ethics, but most of us would begin to doubt the sincerity with which an attorney pursued his case if he were to profit personally by our losing.

Under our fee system, the engineer is in just that position. It is illogical. It destroys equity. It is dangerous. It should be changed.

The architect is in the same unfortunate position as the engineer. Here we are most interested in the engineer, but he all too often is made a party to the architect-client contract. With the increasing importance and complexity of the engineering phases of architecture there has not been the justified reevaluation of fees. The architect cannot pay an en-

RALPH M. WESTCOTT
Holladay & Westcott

Ralph M. Westcott, of Holladay & Westcott, Los Angeles, worked as an employee for only three of the 30 years since he left high school. For the remainder of that time he has been either self-employed or an employer. Westcott completed one year of college and then left to get married. Later he went back to U.C.L.A. for two more years of physics but again stopped short of a degree. He raised dates in the Coachella Valley, made lantern slides for physics classes, and owned and operated a printing plant for about six years. In 1939, he started a water treating service company to handle the special problems connected with refrigeration and air conditioning, and took extension courses in chemistry and engineering. In 1949, he went into private practice as a consulting engineer, receiving his registration in California. Holladay & Wescott was formed as a partnership in 1952, specializing in engineering services in connection with refrigeration, air conditioning, environmental test facilities, heat transfer, and water quality.

Ralph Westcott is now in his second term as president of the Consulting Engineers Association of California. He is a Fellow of the American Society of Refrigerating Engineers and past chairman of the Los Angeles Section. He is also a director of the Consulting Engineers Council and a member of a several other engineering and civic organizations.

gineering fee that is out of proportion to his overall fee, nor can he expect the best for less than an equitable fee.

If it is agreed that the principle of percentage fees is wrong, the problem is to find something to take its place. We cannot throw it out unless we have something to substitute. The engineer must be paid, or there is no engineer.

Obviously, we need some way to pay the engineer for the quantity and quality of the work he does. The system adopted should reward technical ability, speed, thoroughness, and wisdom. It should certainly reward the engineer for savings made for his client. The system adopted should have no direct connection with construction costs or unit operating costs of the engineering office. The pay should be for services that are rendered.

Imperfect Ideal

Unfortunately, such an ideal fee system seems to have its practical drawbacks. While it is possible to find a fee system that does not depend entirely upon construction costs, operating costs of the engineering organization, or time, it is impractical on the other hand, to adopt a system that would reward the engineer for savings afforded the client. While good as an ideal, it could be even worse than the percentage fee system in practice. For example, anyone can reduce the cost of a project by specifying the cheapest equipment — equipment that would have the lowest first cost but might be much more expensive to operate or maintain. Then, while it would appear that the engineer had saved the client money, he actually would have been giving him a shoddy job that would cost more in the end.

Only if it is possible to prove that the quality is equally good, is it possible to pay the engineer for money saved, and it could be 5, 10, or 20 years before an answer could be given to the question of quality of design and quality of equipment specified. It may be possible to find some way to compensate the engineer when he cuts costs and maintains quality in the project, but so far it has not been found. Perhaps it has not even been studied.

Other Possibilities

Some of the other methods are: per diem or hourly rates classified as to types and quality of personnel; cost plus a fixed fee; cost plus a percentage fee; lump sum fixed fees; and not-to-exceed maximum fees.

Per diem or hourly rate will not remove all of the hazards inherent in the percentage system, but it does place the burden for integrity and competence directly on the engineer without a penalty for doing the best job. The client may be penalized by the slow and the dull. The engineer is paid extra for taking more time than he needs, but his profits still will be a small percentage of his hourly charges. Many contracts are based on two and one-half times the hourly pay rate, which generally is accepted as a fair ratio to cover direct costs, overhead, and profit.

This system will work best when the client has a professional understanding of engineering and the engineer is completely conscientious and competent. The client is free to make changes if required, and the engineer can devote the required time to produce the best job at the lowest cost.

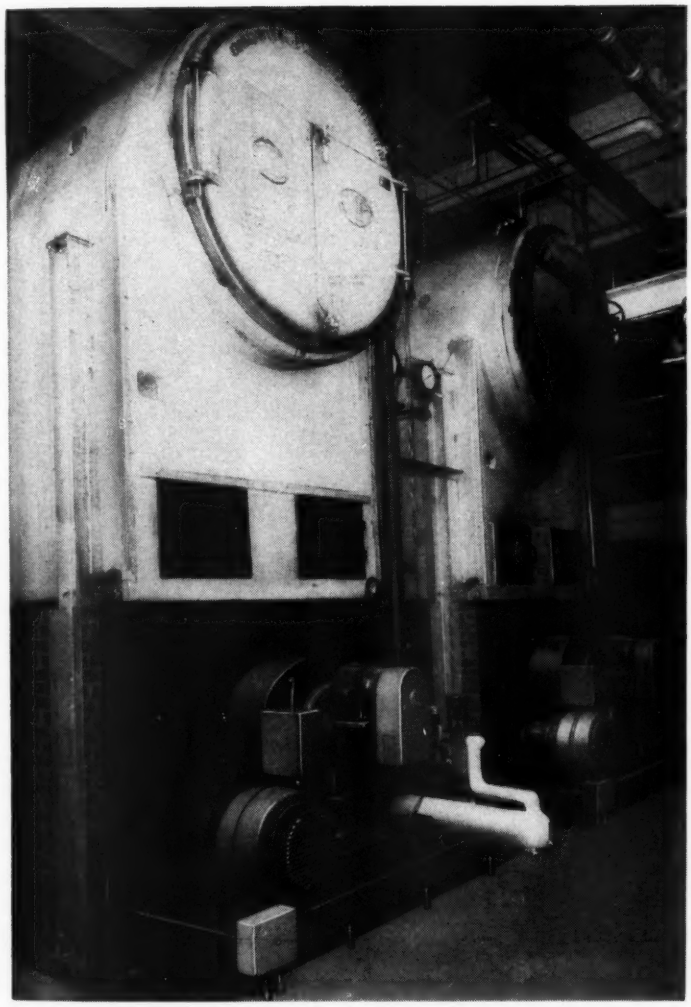
Cost Plus Fees

Cost plus a fixed fee has certain advantages for both the client and engineer. What constitutes costs for the engineer often presents a serious obstacle in negotiation. Costs are all direct costs plus overhead before a profit is realized. Profit should not have to cover selling costs, proposal and negotiation time, and professional activity expenses. In effect, the fixed fee is the guaranteed profit. The ratio of profit for the engineer improves if he can lower his costs, and there is no reward for increasing his costs. Here again the same pitfalls exist for the client if the job is poorly done or takes overly long.

The fact that we cannot achieve the ideal does not mean that we cannot improve upon the percentage fee system. One way to do this is to stipulate a set fee for the job. A set fee must be based on some type of formula, and in establishing the set fee the engineer must take into consideration all of the factors involved, including contingencies. He must consider the type of project and its complexity (which goes back to an estimate of construction costs), he must consider his own firm's operating cost, and he must consider man-hours. It even might be wise for him to take into consideration a number of other factors not usually involved in a percentage fee calculation, such as past experience with that client (does he change his mind halfway through), the client's ability to evaluate engineering services, and his own experience in that type of work. The engineer will arrive at a figure for the fee that will represent a careful analysis of the work required, if he does it with care and to the very best of his ability. This is the figure to be quoted to the client as a firm quotation of the fee for the job.

Additions to the Contract

It is possible to add two clauses to this contract. The first would permit the engineer to increase his fee for additional work brought on by changes in scope requested by the client. The second would be that except for changes this would be the maximum fee, and the engineer would charge only for actual time at stipulated hourly rates. Then no matter what the final cost of project, the maximum fee is established. There is no incentive to increase construction costs. In fact, there is reason to reduce them and please the client. Even though



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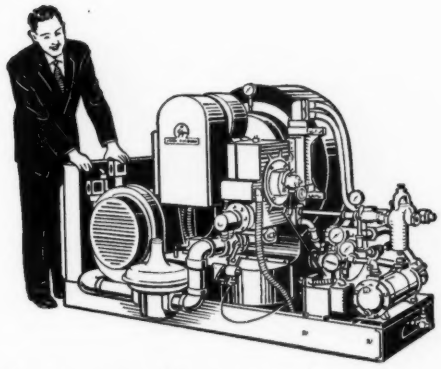

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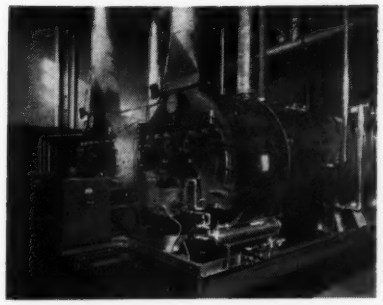

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a reduction in construction costs will not directly benefit the engineer, it will benefit the client and make him happier with the services performed by the engineer. Further if the engineer has saved him money on the fee because contingencies that were provided for have not occurred, the next job will come sooner and with a better understanding between the client and engineer.

Here is an example of how this works. The figures are fictitious, but the example is factual.

A client fixed a preliminary budget for two complex but similar projects at $100,000 each. He interviewed two engineers and heard their proposals. One of the engineers outlined the services he could offer and told him that he would undertake the jobs for a fee of $15,000 each. The other engineer followed the same procedure and told the client that he would take the jobs for 8 percent of construction costs.

The client found that he was in a particular hurry for the job (as usual), and he decided to use both engineers. He awarded a contract for one of the projects to one engineer and a contract for the other to the second.

While it may not be literally true, it is nearly correct to assume that both engineering firms are capable of equally good work. The first one, however, started to work with the knowledge that he was going to get $15,000 for the job. Manpower, technical experience, and time was assigned to the job so that the firm could give the client that much service, less the profit desired. The second engineer estimated that he would receive a fee of $8000, more or less, and he had to go about setting up his operating budget for time and talent in the same way as the first engineer, but he had no where near as much money to give to the job.

More Engineering Saves Money

In this factual example, the contractor's bid on the first engineer's design came in at $90,000. The low bid for the second engineer's design came in at $110,000. This is not an unreasonable spread, but look what it meant to the client. The total cost of the first project was $105,000. The total cost of the second was $118,800. The first engineer with his $15,000 fee may not have made much more money than the second engineer with his $8800, for the first firm undoubtedly assigned more man-hours to the job. But the client saved money, and there is no doubt but that he knew which engineer he wanted on his next project.

The first engineer had every incentive to save his client money, to do the best possible job, and to carry his job through in detail — relieving the contractor of all need to amplify or add to the engineer's work.

Every good engineer knows that he can save his client money on a project if he is paid enough for engineering services to permit him to put in the full man-hours required. This does not necessarily mean more time for completion. Instead, it usually means more and better men on the job — more man-hours, but less elapsed time. The client wins.

Another Example

Another experience illustrates the falsity of the percentage fee and the advantage of the fixed fee. An agency of the federal government had acquired a number of miscellaneous components, and they wanted them assembled into a functioning system. They insisted that the fee be based on a percentage of construction costs, and they wanted the value of the components omitted, since they were not to be purchased. Any engineer will recognize that it takes a lot more engineering work to put together heterogeneous components than it does to design a system with selected components that fit the specific needs of the job.

The cost of the engineering would be more, but the client wanted to pay less — based on a percentage of construction cost fee. It did not make sense. This was explained, and the end result was the equivalent of a fixed fee that took into account the additional engineering services required.

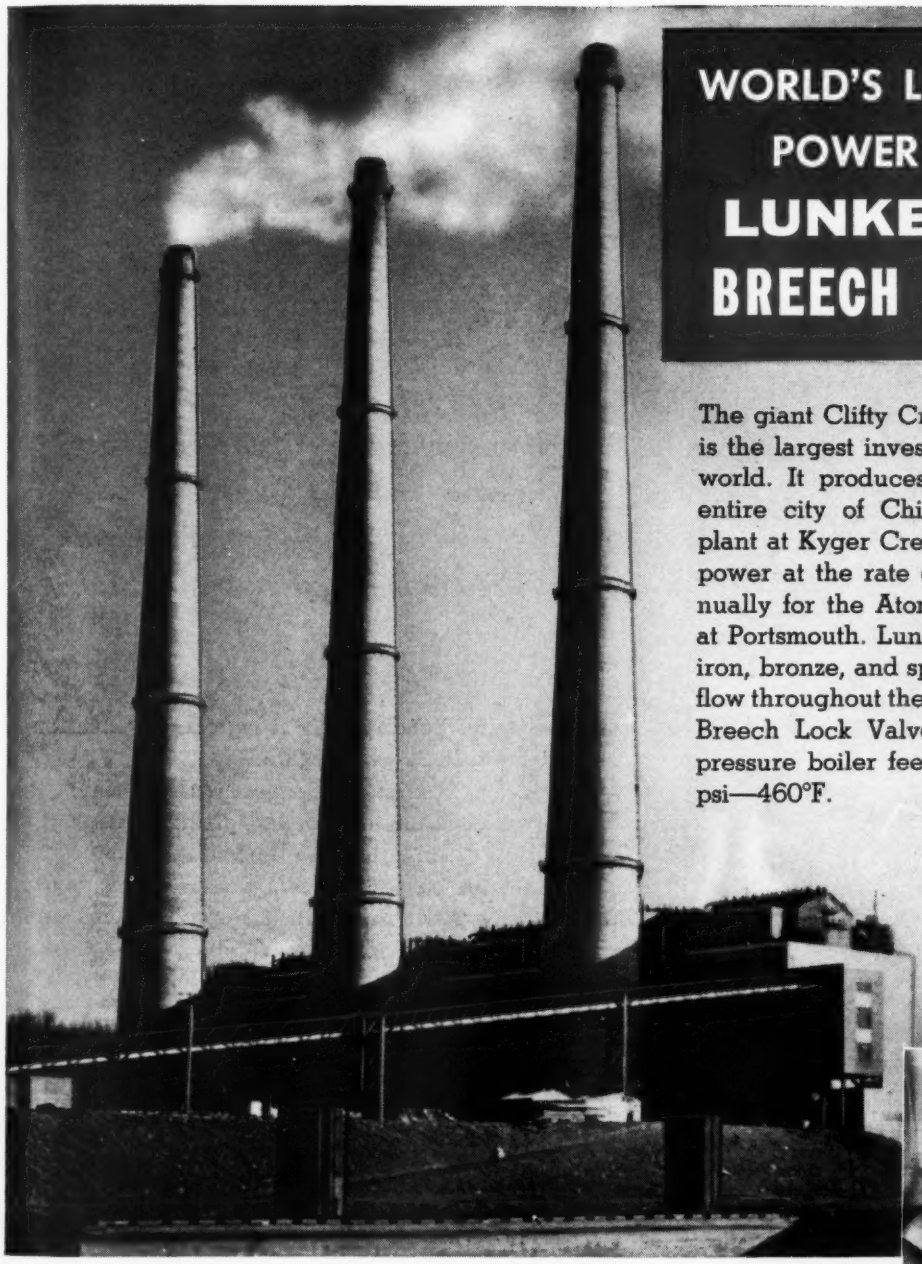
A Fee Fair to All

Outside of the occasional Judas who is willing to betray his profession there is no single element that influences the quality of engineering as much as the fee. We see that percentage fees can be unfair to the engineer, and they can be unfair to the client. Usually they are unfair to both, in that the engineer is underpaid, and the client is overcharged for construction. We see also that the basic principle of paying the engineer more when the job costs more is conducive to unethical conduct and is morally and economically contradictory. While the fixed fee and not-to-exceed maximum fee are not perfect, they are as good as have yet been found. They are to be preferred until a better system can be worked out that will reward the engineer directly for ingenuity and skill.

Building Prestige

One other interesting aspect — we have found that the use of per diem fees or guaranteed maximum fees builds a firm's prestige and increases the demand for engineering services. This method substantially eliminates price competition. The sole criteria for selection is based on competence and reputation of the engineer.

A client is entitled to full value for the fee he pays. The engineer is entitled to what he earns and no more. Any basis for fees should provide for a full and adequate job for the client. The engineer should see to it that his fee is enough to produce that full and adequate job. ▲▲



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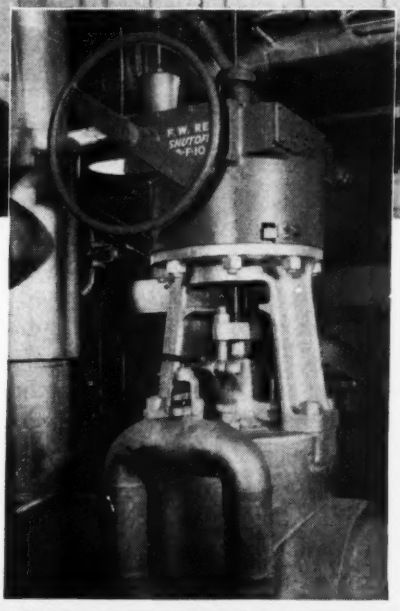
Stacks at Clifty Creek are 682 feet high—the world's tallest. Clifty Creek is owned and operated by Indiana Kentucky Electric Corporation, a subsidiary of the Ohio Valley Electric Corporation, a group of 15 major power generating utilities.



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The motor-operated 12-inch Breech Lock Valves shown here control the North High Pressure Feed Water Inlet at Clifty Creek. Their principal feature is the transmittal of bonnet thrust to the body through interlocking, internal breech-lugs, with the final pressure seal of the body-bonnet joint made by a seal weld. This construction permits the pressure tightness and maintenance-free service of a full-strength welded bonnet, plus the added advantage of easy disassembly and reassembly. The weld can be readily chipped out if necessary. *Write for literature* to The Lunkenheimer Co., Box 360, Cincinnati 14, Ohio.

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The Problems of Private Practice

The Consulting Engineers Association of Oregon wanted to know which problems are most urgent—which should be attacked first. A public relations firm made a survey to find out.

THE CONSULTING ENGINEERS Association of Oregon is a new organization, formed less than one year ago. When founded, it was recognized that the Association's first problem was to find out what needed to be done. It was well known that there was plenty of work to do, but it was impossible to say in what order it should be attacked.

One phase seen as a job was public relations. There were many divergent views on where and how the attack should be made. No one had any facts on concepts prevalent with respect to consulting engineers or how to go about developing a suitable approach to a program for improving public relations.

Rather than go off in several directions at once, the Association engaged a public relations firm to make a survey that would show not only what consulting engineers considered was needed but also what other groups thought of consultants and their work.

The survey was conducted by Dr. Eric J. Weiss, of SCORE, an affiliate of Northwest Public Relations Consultants. Questionnaires were sent to 2300 persons in Oregon and surrounding areas of the Pacific Northwest. While the results apply only to that part of the country, consulting engineers anywhere in the United States readily will recognize a reflection of conditions in their own region.

The survey resulted in a report with certain recommendations. J. Donald Kroeker, president of the Oregon group, comments, "We now do not have to be satisfied with suspecting nor do we have to carry through programs based on the opinions of the man who talks loudest and longest."

Scope of Survey Comprehensive

Internal groups questioned were consultants who are members of the Oregon association and nonmember consulting engineers. Among the external groups surveyed were government agencies, architects, contractors, suppliers, industrialists, teachers.

Members of the Oregon association, when questioned, were found to be in general agreement on the basic issues. Their professional consciousness and their more deliberate approach to existing problems, which originally caused them to join the association, were the reasons for this close affinity of views. Except for a small group of highly specialized engineers, who gave the problem of professional ethics top billing, all other branches considered most important the question of professional recognition, a term subject to numerous definitions, including general consciousness of the difference between a mechanic and an engineer, recognition of the type of service offered, standing among the professions and in the community, and allied problems.

The survey showed that CEAO members consider the urgency of their various problems in the following order:

¶ Professional recognition.
¶ Code of Ethics, and raising standards of profession.
¶ Fees; raising of fee level and standardization; prevention of "fee shopping."

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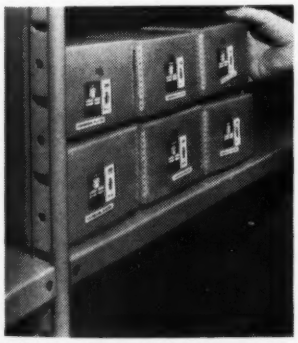
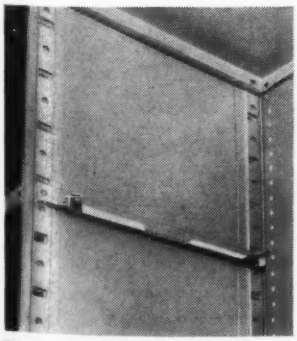


COMMON SIDE PANELS AND POSTS save material between adjacent units in a rack. Back and side panels are one-piece.

BEADED POSTS AND FLANGED SHELVES prevent snagging of clothing or stored goods, protect workers.



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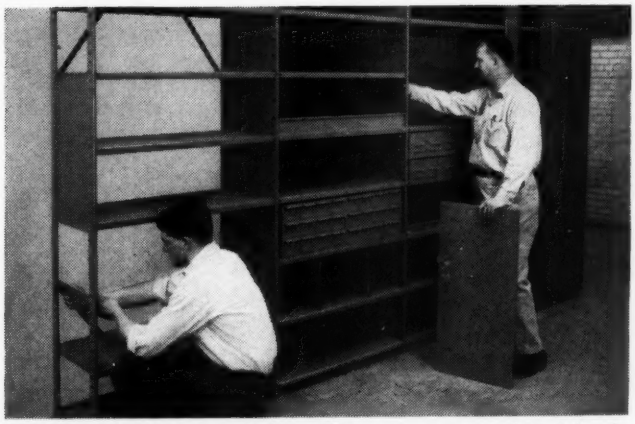
*Patent applied for



TWO MEN ASSEMBLED new Hallowell ERECTOMATIC steel shelving in just over 10 minutes. Closed unit was 36 in. wide, 18 in. deep, 7 ft. 3 in. high, complete with seven shelves. Standard models of other design required 13-55 min. Table shows test results.

Brand	Time to Assemble (Min.)	Units Per Hour
Erectomatic	10.42	5.75
A	13.23	4.53
B	14.24	4.21
C	16.30	3.68
D	18.12	3.31
E	25.03	2.40
F	55.03	1.09

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¶ "Free engineering," and all cases where service should be done by consultants, but is done by others.
¶ Closer collaboration with other professional groups in the respective field.
¶ Standardization of contracts.
¶ Employee problems.

The high place on the list awarded to the questions of professional ethics showed that association members considered ethics an integral part of professional recognition.

"Fee shopping" was considered the most serious problem by 58.8 percent of the members, while 39 percent did not share this opinion. Civil engineers considered "fee shopping" an urgent and serious problem, but mechanical and structural engineers did not stress the problem in their respective fields of activity. In the remaining groups — electrical, heating and air conditioning engineers, and miscellaneous — the answers were divided evenly.

With regard to engineering service which should be performed by consulting engineers but is done by others, CEAO members attributed the majority of violations to "free engineering" performed by suppliers, vendors, and other such groups. Generally speaking, the strongest complaints came from structural and mechanical engineers.

Almost unanimous support was raised in favor of promoting a training program for consulting engineering employees, a fact which becomes significant in connection with the results of the educational survey which showed that engineering students prefer careers offering such opportunities.

CEAO members felt that among the training problems, completeness of drawings in accordance with existing codes and ethical standards is one of the first things that should be taught. Economy of design was listed as second.

The consultants also thought the trainees should be taught report writing and proper English usage, and familiarity with up-to-date materials and methods. One member suggested the possibility of organizing a training program in conjunction with the Extension Division of the Oregon System of Higher Education.

Cooperation with Other Groups

A clear-cut decision was reached on the question of whether CEAO should form joint committees with AIA, ASME, ASCE, and other related professional groups in order to take action on issues of mutual interest. Almost 83 percent were in favor of close collaboration with other engineering groups.

While employee problems were placed last on the priority list of critical issues, 78 percent of the consultant members said they had difficulties in enlisting suitable personnel. This, at first, appeared to be contradictory. However, it is to be remembered that the above question asked only about the existence of that particular problem and not about its urgency. The survey states that the problem undoubtedly is there, and it apparently is growing in intensity without yet having reached the severity of those problems by which it still is outranked.

Salaries and other incentives offered by industry were considered by 60.9 percent as the principal reasons engineers are attracted to jobs in industry. Students questioned later showed that 49 percent plan an engineering career in private industry. They expect to find top salaries but they also say they anticipate professional satisfaction.

These viewpoints — those of CEAO members and the engineering students — clearly indicated that salaries, although the most decisive factor, shared the field with other incentives. The survey suggests that to solve the personnel problem, money is not the only answer. Consulting engineers will have to offer their potential employees greater "spiritual values," and when they do, they will have to make it better known.

Salary Increases

The consultants were divided on the question of whether a raise of employee salaries actually is feasible. Replying in the affirmative were 41.1 percent.

When asked where the salary increases should be applied, the engineers stated that increases should be given both in initial salaries and pay raises for seniority. In favor of the two increases were 19.5 percent, while regular pay raises for seniority was given 13.7 percent, and initial salaries, 2.4 percent.

As an alternative to salary increases, some system of employee participation was preferred as an incentive by 41.4 percent. The survey suggests that the solution lies "somewhere in the middle," and one CEAO member suggested a combined system of pay increase plus bonus.

A majority of members questioned were opposed to a system of "satellization," whereby certain employees are given the opportunity of becoming semi-dependent, and eventually, with the support of their employer, fully independent. Voting against the employee satellites were 36.6 percent, while 29.2 percent were in favor of the program. The survey suggested that the negative majority might be due to unfamiliarity with this type of program.

The final question relating to employee problems, "Are you in favor of standardization of wage scales and of pooling information on current wage rates" resulted in a "Yes" vote by 63.4 percent.

However, many of those who voiced approval did so with reservations. Some favored pooling of information on current wage rates only, and others would accept standardization as long as safeguards were provided against collusion in holding down wage scales. The survey pointed out that the financial capacity of the individual employer and his eventual ability or disability to meet standardized wage scales influenced the viewpoints on this matter.

A bill "to create a seven-member building and con-

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struction standards advisory council," introduced in the Oregon State Legislature by R. F. Chapman on February 12, 1957, made the next question of the survey a timely one. CEAO members were asked if they favored standing code committees of CEAO to arrange for consultation with local authorities who are regarding contemplated changes of local construction codes.

In favor of organizing such committees were 85.3 percent, with 9.7 percent opposing.

The proposed bill does not include representation of consulting engineers on the suggested council, so the large majority coming out in favor of the standing CEAO committee is significant.

Written Agreements

Among all questions, the one containing the suggestion that all major services by consulting engineers should be based on written agreements, which would include certain protective provisions, received the strongest approval by CEAO members. These arrangements were favored by 92.6 percent, with 7.3 percent disapproving.

A question asking if all contracts should be standardized, was approved by a comparatively slim margin of 48.7 percent, with 39 percent against it.

Many members objected to the word "all" in reference to contracts. Quite generally, the necessity of flexibility for contracts, taking into account the great variety of possible services by consulting engineers, was emphasized.

The somewhat cautious approach in the matter of standardized contracts was confirmed by answers to the connected question — should a standardized contract be patterned after the Government contract form. The response left no doubts. CEAO members said "no" by a majority of 46.3 percent, with 4.8 percent voting in favor of the Government pattern. The mental picture of cumbersome, inflexible, and long-winded Government forms, garnished with red tape, clearly made CEAO members decide that if there should be standard contracts, the forms should be determined not by a rigid formula but by the purpose the forms are supposed to serve.

Prospective Association Members

Consulting engineers who are not CEAO members and who did reply to the questionnaires indicated a widespread interest in matters concerning the profession. The completed questionnaires showed that 46.1 percent of the consultants replying intend eventually to join CEAO. Another 34.6 percent said they do not wish to become members. An additional 7.6 percent are undecided. Others did not answer.

The survey showed that CEAO may assume that more than half of the nonaffiliated consulting engineers in Oregon could be induced to join. One remark, quoted from a consulting engineer in central Oregon, said: "Would like to know more about present activities, membership, and future aims of this organization."

Which professional problems are considered most pressing by nonaffiliated consulting engineers? The listing, as given by nonmembers, was:

¶"Free engineering" and all instances where services should be performed by private consultants but is done by others.

¶Code of Ethics, and raising standards of profession.

¶Fee; raising of fee level and standardization, prevention of "fee shopping."

¶Recognition of profession.

¶Closer collaboration with other professional groups in the respective field.

¶Employee problems.

¶Standardization of contracts.

In comparing this priority list with the one resulting from the survey among CEAO members, there is almost complete identity except for a reversal in order of the last two items and disagreements on the urgency of "free engineering" and recognition of the profession.

While CEAO members recognize public acceptance of the profession as the basic problem, nonmembers relegate it to the fourth place and put the fourth item from the CEAO classification, "free engineering," at the top of their list. The survey pointed to this difference in approach as explaining why some consulting engineers are organized in an association and others are not.

Objections to Affiliation

What are the objections raised by nonaffiliated consultants to joining CEAO? This is the order in which they classified them:

¶There exists specific problems for consulting engineers, but CEAO is not equipped to settle them.

¶Already being a member of several professional organizations, additional payment of dues would be too burdensome.

¶There are no specific problems that could not be dealt with by existing professional groups.

The main objection by those who at present are not willing to join the association—that it is not equipped to cope with existing problems — constitutes a challenge of a very constructive order. It opens the door for CEAO to embark on a twofold task: to correct existing shortcomings and to enlighten those who complain about nonexistent weaknesses.

Quotes from nonaffiliated consulting engineers included:

"Revision of engineers' registration law should be given high priority. Present law is superseded by architects' registration law, for which lawyers and the courts have a higher regard than the engineers' registration law. No cases have been carried to Supreme Court to decide validity of engineers' law."

"I am of the opinion that until the ethics of engineers are enforced by adequate legislation, the ma-

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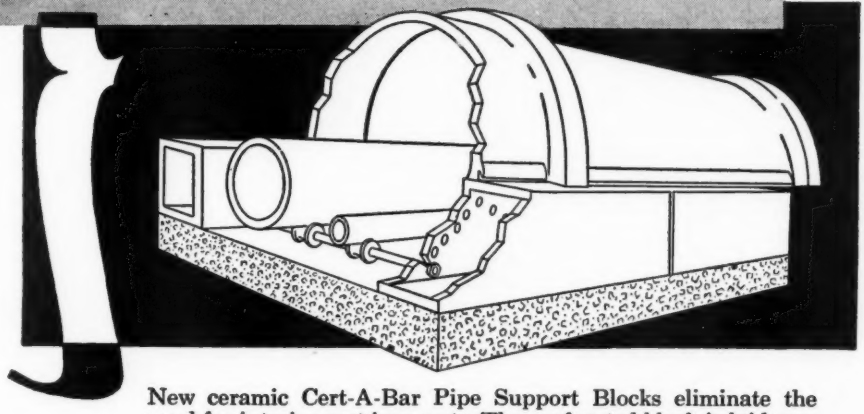

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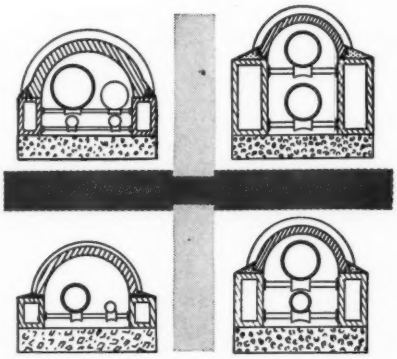

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jority of engineers, regardless of their aspirations, will remain little more than technicians."

Architects Show Interest

Because architects represent a large and important single professional group with which consulting engineers maintain extensive professional contact, the survey questions given to the architects were to obtain information, which, constructively evaluated, would help to make the architect-engineer relation a harmonious and efficient one.

The architects apparently understood this, because 29.4 percent of those polled replied to this survey.

The basic question was aimed at finding out how many architects have professional contacts with engineering groups. Of the architects questioned, 97.5 percent use the services of consultants.

The distribution of fields of engineering services used by architects is:

Mechanical	92.5%
Electrical	88.3%
Structural	62.5%
Foundation	16.6%
Acoustical	3.3%

The following table shows the percentage of architectural offices who have engineers on their payrolls and the branch of engineering involved.

Architectural Firms Employing:

Structural	25.0%
Mechanical	7.5%
Electrical	7.5%
Foundation	6.6%
Industrial	0.8%

While structural engineers rank only third among the consultants retained by architectural offices, they lead the field of engineers employed on the staff of architects.

When asked if they would increase their engineering staff if manpower was available, 63.3 percent said they would not, while 15.8 percent would.

Those who would consider hiring additional engineers preferred the following specialized fields:

Mechanical	13.3%
Electrical	10.0%
Structural	5.0%
Soil	0.8%
Civil	0.8%

As to the number of engineers they would hire if possible, no architect wanted to add more than three to his staff. However, some architectural offices in the State of Washington wanted to add as many as four, and in California, up to 20 engineers.

Architect-Engineer Relations

Turning to the main problem of mutual relationship between architect and consulting engineer, the question concerning the architect's satisfaction with engineering service was divided into two components — the purely technical side and cooperation.

Satisfaction with the work of consulting engineers was expressed by 75.8 percent of the architects, with only 4.1 percent expressing outright dissatisfaction. Qualified satisfaction was expressed by 10.8 percent.

The consulting engineers were listed as cooperative by 83.3 percent of the architects, with 5 percent expressing dissatisfaction. About 6 percent qualified their answer when saying engineers cooperate.

On more specific questions, blame for errors or omissions on past projects was attributed to:

Mechanical engineers — by 16.6% of the architects questioned.

Electrical engineers — by 5% of the architects.

Structural engineers — by 1% of the architects.

Failure to meet deadlines set by the architects was blamed principally on:

Mechanical engineers	19.1%
Electrical engineers	10.0%
Structural engineers	4.1%
All branches	2.5%

The inspections consulting engineers give buildings or projects were listed as satisfactory by 55.8 percent of the architects, with 24.1 percent saying they were dissatisfied. Satisfaction, with reservations, was expressed by 6.6 percent.

The number of inspections on a project usually is two, on certain projects either two or three, and in singular instances up to four.

The Type of Fee Preferred

The architects were asked if they prefer to pay the consulting engineer on a fixed fee basis or on an hourly basis. About 60 percent favor a fixed fee basis, with 10.8 percent preferring payment on an hourly basis. Many qualified their answer by saying that the basis for payment is dependent on the nature and size of the service performed.

In general, fixed fees are favored for large jobs, for work on new projects, for mechanical engineering work, for electrical engineering work, and for structural engineering work.

However, many architects prefer an hourly fee basis for small jobs and alteration work, with some also preferring the hourly fee for structural and electrical engineering work.

The survey concluded that the majority of architects prefer to pay the consulting engineer on a fixed fee basis, thereby putting the emphasis on new or larger sized projects.

Of those who favored fixed fees, 45.8 percent of the architects felt that a standardization to achieve greater uniformity of fees was desirable. Opposition was expressed by 15.8 percent.

Not Enough Consultants

One architect commented that he would like to use more consulting engineers but "I am not going to hunt for them. They seem hard to find."

An Idaho architect added that mechanical and elec-

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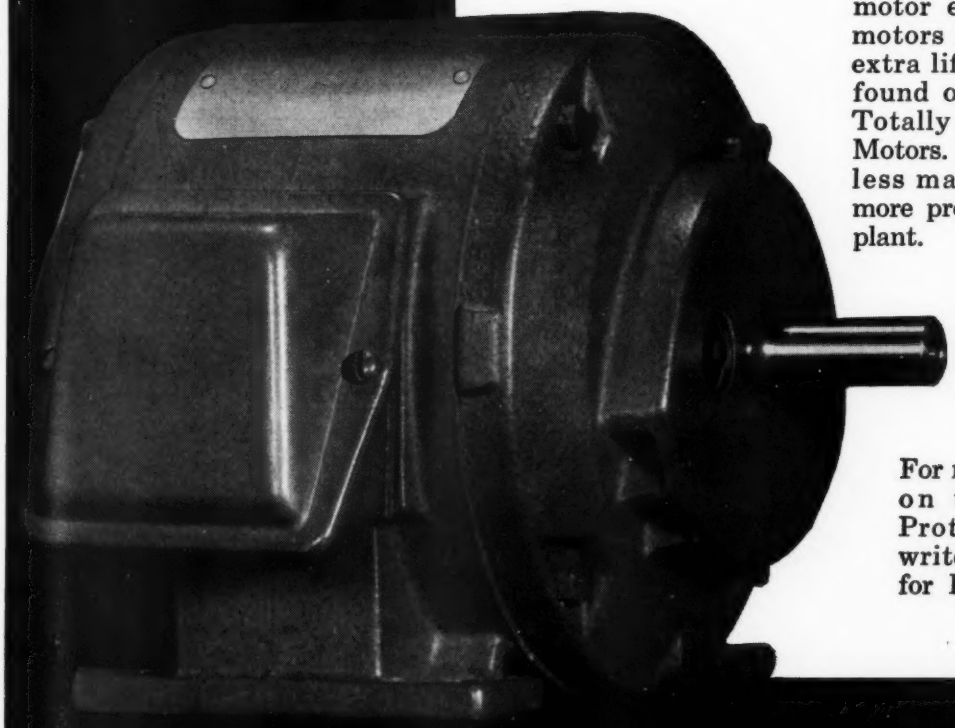

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trical engineers are nonexistent in his area. He said that poor service from Spokane and Seattle engineers has forced him to do his own work.

Few Contractors Reply

Comparatively few — 15.2 percent — of the contractors queried replied to the survey. The survey noted that the answers from this group of contractors were quite indicative, not so much by their consistency, as by their discrepancies.

The contractors, first, were asked if their offices employed the services of consulting engineers. "No" was the answer of 65.7 percent, with 22.8 percent saying they did. These figures might indicate that about 11 percent of the contractors do not know whether they use consulting engineers. However, the discrepancy was answered partially by later questions.

Of those contractors who said they used the services of consulting engineers, none indicated they did so regularly. About 37 percent said they used consultants occasionally.

Analyzing the first two questions asked of the contractors, the survey concluded that 62.9 percent of the contractors do not employ consulting engineers, while 37.1 percent do.

One fact, however, cannot be challenged. No contractor who replied to the survey uses a consulting engineer on a regular basis.

The contractors next were asked, "Do you ever design or construct for an owner?" Their answer was:

No	40.0%
Yes	48.5%

Here again, the next question contradicted their answers. About 40 percent of the contractors said they occasionally do their own engineering design, and 14.2 percent said they regularly do. This exceeded the 48.5 percent who previously said they do designing and constructing for an owner.

Apparently, most of the contractors did not feel that a job done by an engineer tends to be overdesigned and thereby costs the owner more money. Of those questioned, 31.4 percent said no, and 20 percent felt that engineers did overdesign.

One contractor volunteered the information that "Designs are usually clearly drawn but frequently overspecified with meaningless technicalities from textbooks of the engineer's time of schooling and not brought up-to-date. This also applies to architects."

Contractor Personnel

Who else, besides the contractor himself, prepares designs in the contractor's office? In order to obtain a candid answer, a distinction was made in the prepared question between two kinds of engineers employed on the payroll of the contractor's office — the professional engineer, and, as it was diplomatically termed, the practical engineer. Some 20 percent of the contractors said they employ professional engineers, while 28.5 percent use "practical engineers."

In contrast to questions concerning consulting engineers' services for their own offices, the response from the contractors to the question, "Do you prefer to bid for contracts based on plans designed by engineers?" was a clear-cut and consistent one: yes, 94.2 percent and no, 2.8 percent.

When asked if they think architects should employ consulting engineers to design projects or buildings, 82.8 percent of the contractors said yes, and 5.7 percent said no.

Engineers Do Better Job

The contractors' approval of consulting engineers again was expressed in an answer to "Do you think the owner will receive a better job if it is based upon a plan designed by a professional engineer?"

Yes	85.7%
Yes, with reservations	5.7%
No	8.6%

One contractor explained "Yes, if the job has any structural complications; no, if the job is run-of-the-mill building."

The contractors became more critical when asked specific questions referring to their own day-to-day practice. Here 17 percent said the plans that they received from engineers are not clearly drawn and the specifications are not clearly stated. Satisfaction with plans and specifications was expressed by a 45.7 percent. However, 37 percent of the positive answers had strong qualifications.

The survey concluded that the engineers' performance tends to be uneven and suggested this as the basis of the low percentage of consulting engineers retained by contractors.

The concluding question directed to contractors was: "Do you agree with specifications stating that all substitutions of materials shall be submitted five days prior to bid opening and all materials submitted thereafter shall be rejected regardless of quality and price?"

No	65.7%
Yes	25.7%
Qualified consent	2.8%

Next month, CONSULTING ENGINEER will publish answers to questions put to other groups including suppliers; government, trade, and professional associations; industry; students; and teachers. ▲▲

Report from Manila

VICENTE M. DECIPEDA, Chief Engineer
Industrial Development Center, Manila

IN THE PHILIPPINES, the problem of economic advancement is in the foreground of national consciousness. A major endeavor of the government's economic development program is the establishing of essential industries and improving the productivity of existing firms. The direction that these efforts take and the outcome will be a vital force in strengthening freedom, national security, human dignity, and social progress in this country.

As the pace of industrialization is stepped up, the need for consulting engineering services increases accordingly. Very soon this new technical field will be fully developed, for it is necessary to a sustained economic progress.

Manila Consultants

At present, there are only 10 registered consulting engineering firms in Manila. Their scope of services ranges from report writing to designing projects. The staffs vary from 2 to 25 specialists.

One of the most outstanding consulting engineer firms in Manila is the Engineering and Development Corporation of the Philippines (EDCOP). This firm is an associate company of the Aetna Standard Engineering Company of Pittsburgh, Pa. At present, the EDCOP has a joint venture agreement with Tippetts-Abbett-McCarthy-Stratton, of New York, to furnish engineering services for a proposed hydroelectric project of the National Power Corporation, which is a semigovernmental entity.

EDCOP specializes in power development, industrial and management engineering, and plant site selection. This consulting firm has worked with fertilizer, ramie (a bushy Asian plant cultivated for its strong fiber), rubber, and power projects. In addition to its work in the Philippines, EDCOP has clients throughout the Far East.

Other Manila consulting engineering firms include M. J. Gonzales and Associates, Borromeo and Lim, Jose C. Espinosa, and the Pacific Business Consultants, Inc.

Consulting Services

A large part of consulting work done by engineers or consulting organizations involves handling complete projects. Such service includes one or more of the following activities:

¶ Preparation of design and construction drawings.
¶ Analysis of requirements.
¶ Selection of equipment.
¶ Securing and analyzing bids.
¶ Assistance in letting contracts.
¶ Supervision of construction.
¶ Inspection of equipment and materials for projects.
¶ Approval of payments.
¶ Final inspection and reports.

The rendering of consulting engineering service is on a highly professional basis and governed at all times by an established code of ethics. A written contract or agreement between the consulting firm and client always is prepared for each project. Here the scope of work is defined, services needed are described, and the basis of compensation is set forth. The responsibility of each party to the contract also is clarified.

The fees and manner of making charges for professional consulting services have been patterned

in the broad aspect upon reports of the ASCE. In view, however, of the basic difference between civil and mechanical engineering projects, methods of fee setting differ. In most cases, it is possible to base fees for civil engineering work on cost of the project. This is not a suitable criterion for determining mechanical engineering fees.

Fees for personal services, appraisals and valuation reports, inspection and testing of apparatus, and similar types of activities requiring no design or drawing work usually are based on per diem rates. These services fall under short-term contracts if the work does not take more than one week. Rates per day vary from 100 to 500 pesos, depending upon the nature of technical knowledge required. For projects taking one week to 10 days, per diem rates of 50 to 75 percent of short engagement rates are used as a fee basis. For consultation work in excess of 10 days, fees generally are based on actual salary rates of personnel employed plus a reasonable amount for overhead, executive expense, and profit. Where special technical assistance is provided, billing at three to four times the payroll is common.

It also is not unusual to charge cost-plus-fee or cost-plus-percentage for reports, testing, and other services. In such cases, cost is defined as cost to the consulting firm and includes all items of direct cost of services plus an overhead allowance of 75 to 100 percent of the payroll. The fee then is based on the sum of direct cost and overhead, with 40 to 50 percent added.

It sometimes is desirable to use a combination of the per diem and cost-plus-percentage basis to determine fees. In such cases, the services of principals or executives of a consulting firm are on per diem rates, but the time of staff engineers or assistants is billed at cost plus an allowance for overhead, and an allowance for profit.

In cases where a consultant is retained intermittently over an indefinite period of time, an annual retainer fee is paid by the client company to reserve the consultant's services. Such a retainer fee is determined by the number of days of service required annually. If additional time is needed, the minimum per diem date for the type of service and the experience of the consultant is agreed upon.

A sliding scale of minimum consultation fees based on percentage of the project cost of work is followed when possible. For complete mechanical engineering projects, consultation fees vary from 8 to 14 percent of net project cost, with lower percentages for complex projects costing 600,000 to 1,000,000 pesos. Projects which would require an outlay of 50,000 pesos or less are billed at 14 percent. Where the scope of work cannot be foreseen and sliding fees are not acceptable to both parties, charges for services are determined on cost-plus-fee basis. ▲▲

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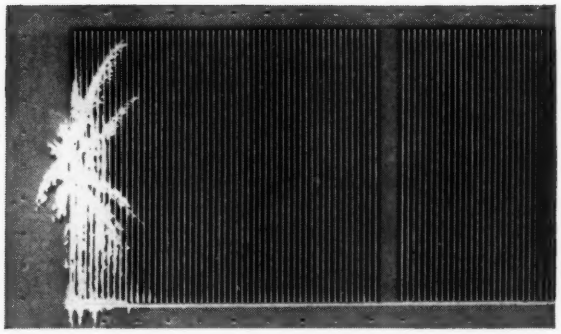

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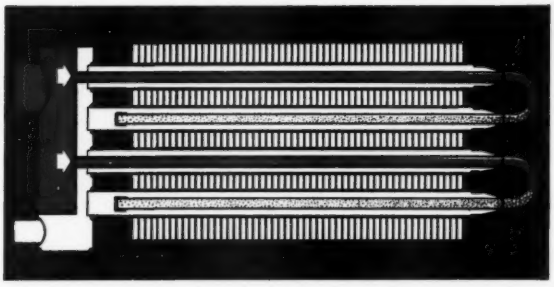

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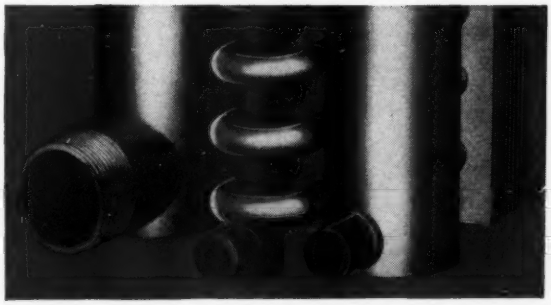

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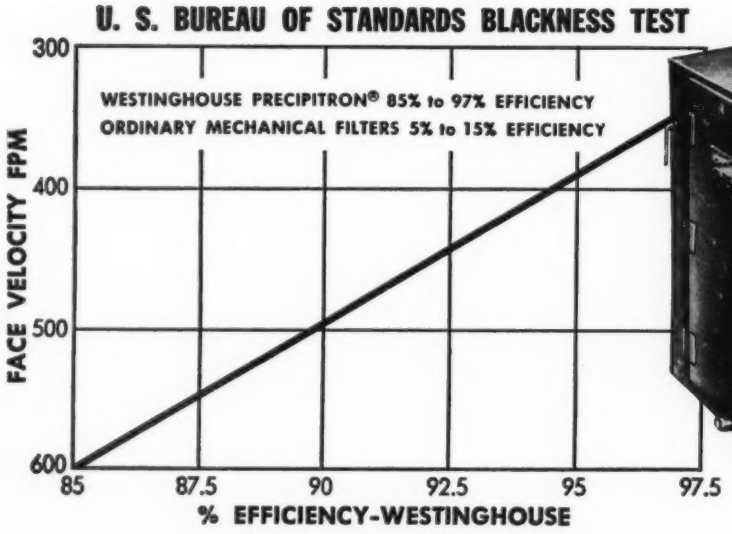

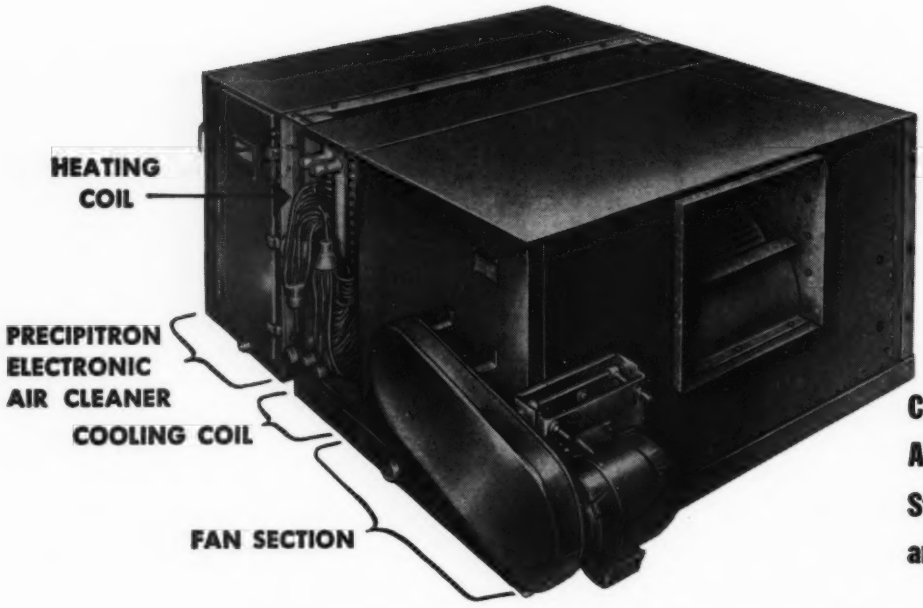

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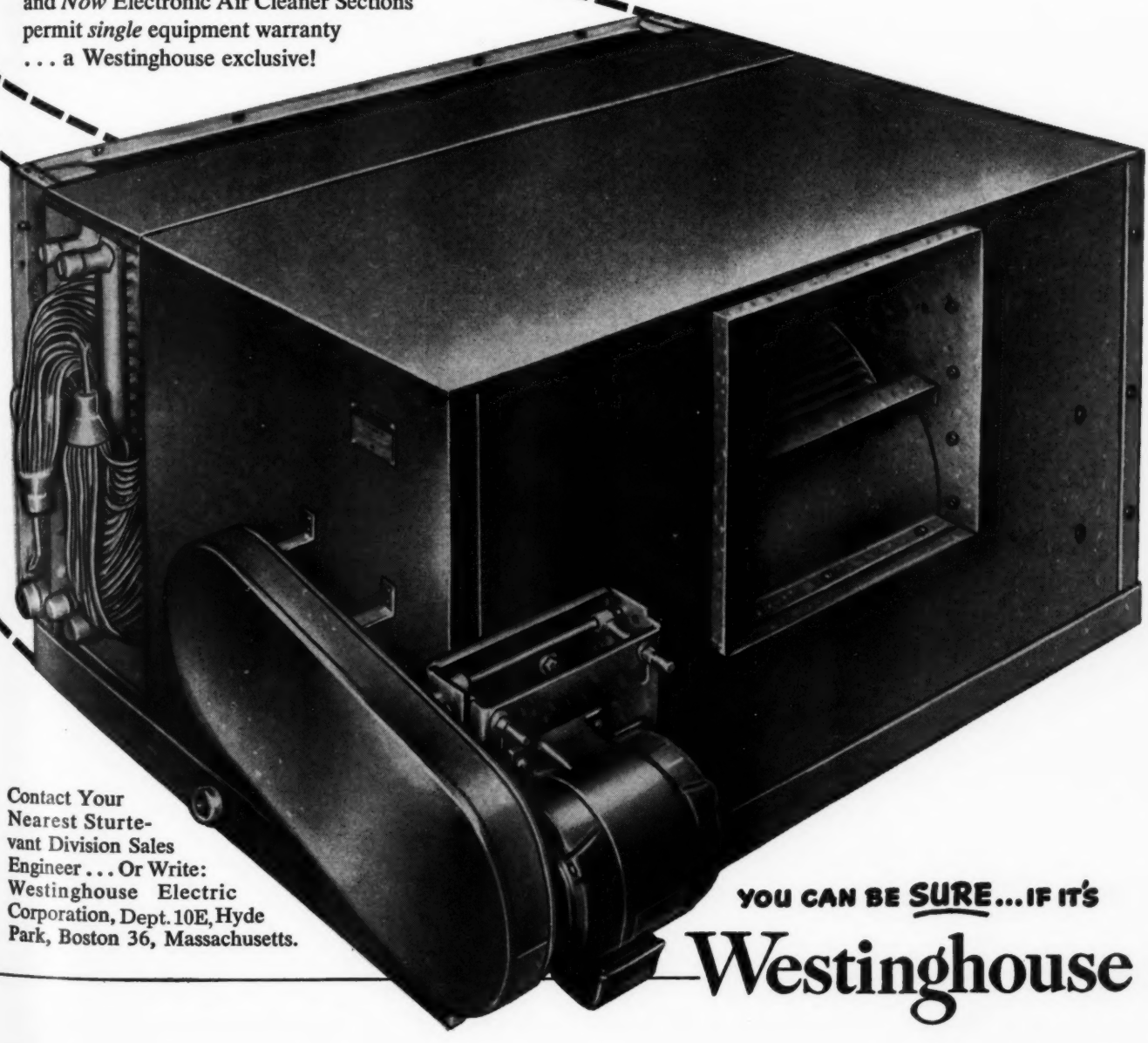

Contact Your Nearest Sturtevant Division Sales Engineer . . . Or Write: Westinghouse Electric Corporation, Dept. 10E, Hyde Park, Boston 36, Massachusetts.

YOU CAN BE SURE... IF IT'S

Westinghouse

Notes From Abroad

Peruvian Dam in Operation

Cerro de Pasco's Paucartambo hydroelectric power project, which has been under construction high in the Peruvian Andes for more than five years, now is in operation. Cerro de Pasco is an American-owned firm.

Water of the turbulent Paucartambo River, which has its source high in the Andes, has been dammed at a site in the Paucartambo Valley known as Yuncan. When the project is in full operation, 72,000 kva can be transmitted 89 miles to La Oroya, the location of smelting and refining operations of a Cerro de Pasco subsidiary.

From the headwaters, the Paucartambo is diverted into an eight-mile tunnel bored through the mountains and is discharged down a 3800-ft steel penstock to the power station.

In order to complete the project, a 65-mile access road was carved out of the Andes at a cost of $5 million.

Spanning the river at Yuncan is a 230-ft dam consisting of a 130-ft free spillway and a controlled spillway. From the gates, the water enters a curved canal that connects with a dual-basin sandtrap. The flow of water into the tunnel is regulated by a forebay.

To supplement the Paucartambo River water during the dry season, water is diverted into the main tunnel from the Manto River by means of a concrete arch dam, diversion tunnel, and connecting raise. Plans also are underway to divert the waters of the Santa Isabel River into the pond above the Yuncan dam.

Emerging from the main tunnel at Yaupi Alto is the penstock that conducts the water to the powerhouse below. The penstock, with an outside diameter of about seven feet, goes down the mountain at an angle of about 25 degrees. At the powerhouse below, the penstock branches into three tubes, each of which supplies water to a single turbine.

The powerhouse, located downstream about 11 miles from the dam, houses three Westinghouse generators. With the development of further water storage area, it is possible that one, and possibly two, generators will be added.

The 138,000-v transmission line is reported to be the first of such lines installed at altitudes above 12,000 feet. Supporting it are 568 towers of two, three, and five wooden poles. Because of the rough terrain through which the line passes, it was necessary in many instances to shoot rope across canyons by means of a Lyle gun in order to pull the wooden poles and transmission cable into the desired position.

In addition to the main step-up transformers at Yaupi Bajo, the Paucartambo project provides for two new substations, one at Carhaumayo and the other at La Oroya.

The power production and transmitting facilities were designed by Ebasco Services, Inc. of

YUCAN HEADWORKS FEATURES A 230-FT DAM AND A SANDTRAP.

PLUS A 3800-FT PENSTOCK.

One of a series appearing in **FORTUNE** *and leading architectural magazines.*

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Lewin-Mathes' quality strikes a responsive accord.

Despite the large number of new customers for Lewin-Mathes Copper and Brass tube, pipe and rod in recent years, better than 90 per cent of our business comes from *repeat* customers. High fidelity of a rare order!

So long as we remain faithful to the highest standards of tolerance, temper and uniformity, we can expect our customers to remain loyal to Lewin-Mathes products. And as specialists—with a *completely integrated* plant designed specifically for the manufacture of tube, pipe and rod—it's in our own best interest to be *perfectionists.*

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New York, which also supervised construction of the project.

Cost of the facilities, exclusive of the access road, is estimated at $25 million.

Jordan Investment Guaranty

The International Cooperation Administration has issued guaranty insurance covering losses in Jordan to Edwin W. Pauley, an independent oil producer from Los Angeles. Maximum reimbursement is fixed at $1.5 million during the first year, $3 million during the second year, and $6 million from the third to the 20th year.

The guaranty is the first to cover an investment in Jordan since that kingdom agreed to cooperate in the U.S. Investment Guaranty Program in 1956. It also is the first such contract made to protect a U.S. investment in petroleum exploration and drilling abroad.

The guaranty insurance would provide reimbursement for financial loss suffered if Pauley's investment in Jordan should be expropriated. Jordan gave Pauley rights to explore and drill for petroleum, natural gas, and other hydrocarbons in an area covering one-third of the 37,000-sq-mi Middle East kingdom.

Industry Cuts Corners

An industrial building, in the shape of a 25-sided polygon, is being constructed in Oakville, Ontario, Canada.

The structure, 128 feet in diameter, features a shallow dome roof with a ceiling height ranging from 9 to 18 feet. Each of the polygon's sides is about 16-feet long.

The concrete block walls will have earth banked against them almost to the roof line. Windows will be installed only 30 degrees from horizontal, just under the roof overhang.

The building, with a 13,000-ft main floor, will have a smaller second floor near the center for service facilities. The central location was chosen so that office facilities will be handy to all departments.

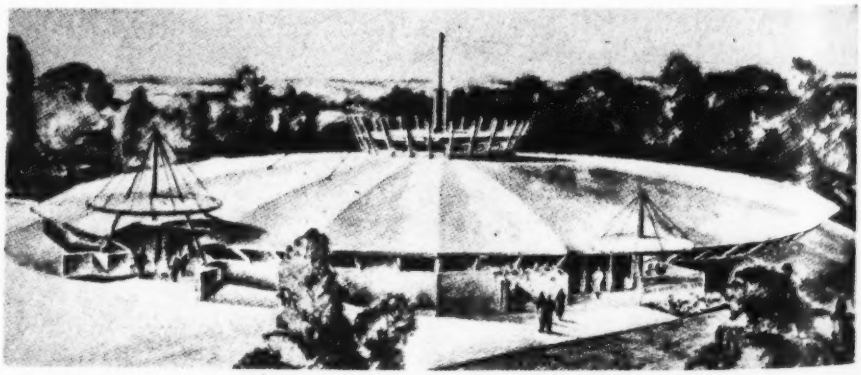
Because of the circular shape of the building, staff and materials can move to any point in the plant with a minimum of effort.

Analyzes European Methods

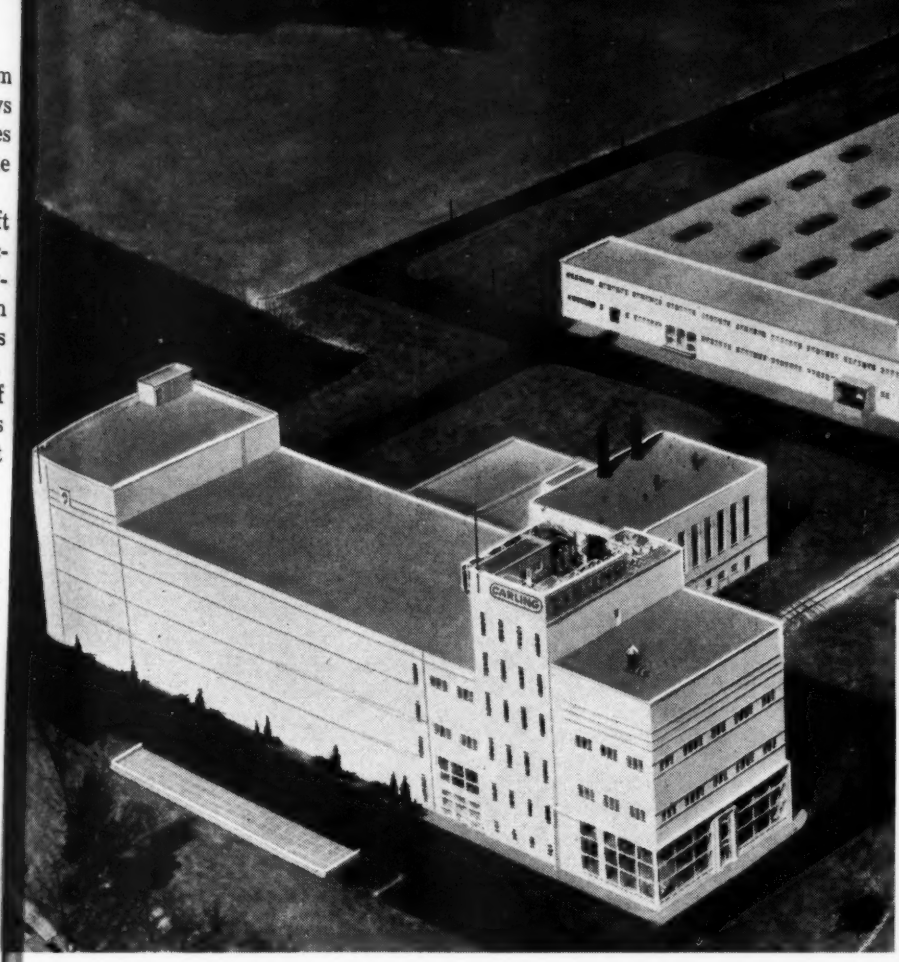
Mass production of building materials was recommended to save time for European architects and engineers by Edward X. Tuttle, vice-president of Giffels & Vallet, Inc., L. Rossetti, Detroit firm of architects and engineers, speaking before the Danish Civil Engineers' Society and the Federation of Danish Architects. He pointed out that "Whether we like it or not, we are living in an era in which the standards of living are based upon mass production and automatic techniques."

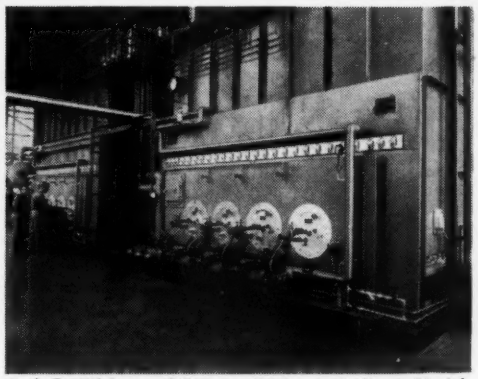
Tuttle spent a year in Europe as one of a team of American consultants retained by the European Productivity Agency to inform European builders, engineers, and architects regarding the preparation of complete and final plans prior to awarding of contracts for building construction.

Giving the Danes some examples of building techniques that could be improved. Tuttle recalled an Italian idiosyncrasy that makes progress toward mass production difficult: "They persist in



CANADA SCORES A " FIRST," WITH THIS 25-SIDED POLYGON BEING CONSTRUCTED IN OAKVILLE, ONTARIO. THE BUILDING WAS DESIGNED FOR EASE OF OPERATION.





Each B&W Integral-Furnace Boiler at Carling's Natick plant has a capacity of 58,000 lb of steam per hr at operating pressure of 150 psi and 200 psi design pressure. Plant designed by: Carling Brewing Company, Engineering Department, Cleveland. Architect: John Marshall, Canadian Breweries, Ltd., Toronto. General Contractor: Gilbane Building Co., Providence, R. I.

B&W Integral-Furnace Boilers Prove Reliability at Carling's

TWO UNITS ASSURE CRITICAL TIME CYCLING IN BREWING PROCESS

Carling Brewing Company's Natick, Mass., plant, the first new brewery in New England in more than 40 years, produces 600,000 barrels of Red Cap Ale and Black Label Beer a year. Steam for the brewing process, pasteurizing, sterilizing, and heating the plant is supplied by two B&W Integral-Furnace Boilers.

One Unit Alone is meeting the plant's maximum load of 35,000 lb of steam per hr, with the second on a stand-by basis. This boiler-room schedule is part of the plant's overall design, which will permit adding another 600,000 barrels of capacity when required.

After a Year of Operation, Lewis R. Grant, Chief Engineer, reports that the oil-fired boilers have given instantaneous response to load changes and are operating at high efficiency. There has been no maintenance necessary since the boilers went on the line.

Reliability Is Important at the Natick plant because of the exacting time cycling of the brewing process. The B&W units have easily met this test. The steam delivered has been clean and dry, with no indication of solids carry-over.

B&W Integral-Furnace Boilers, for any steam requirements up to 350,000 lb per hr and for all fuel conditions, incorporate installation, operating, and maintenance features that give greater boiler efficiency, availability, continuity of service, and overall economy. They provide maximum capacity in small space, high fuel economy, smokeless combustion, and economical, fast steaming. Completely integrated units, they are backed by the undivided responsibility of a single manufacturer, with nearly a century of steam generating experience. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

G-839-IB

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BOILER DIVISION

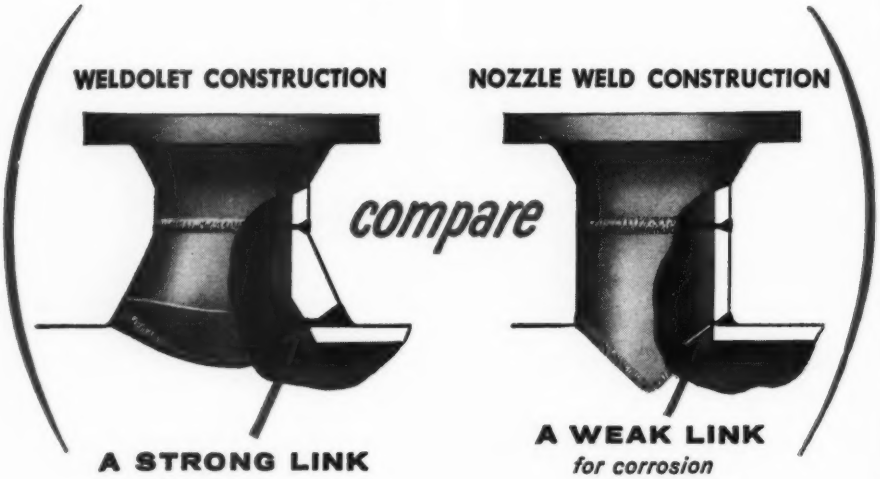
→ **years** to your piping

→ **gallons** to your flow

→ **strength** to an otherwise weak link

add → **BONNEY WELDOLETS**

to your piping drawings for all branch connections



A STRONG LINK
adds years
gallons
strength
and assures a clean, properly fabricated and properly designed branch connection

A WEAK LINK
for corrosion
external forces
internal pressure

Labor costs are now at an all time high. Reevaluation of your piping costs will now reveal Weldolets 4" and smaller to be less costly to fabricate than unreinforced nozzle connections. In the field this is also true of larger sizes and Weldolets are always more economical than branch connections made by welding tees or reinforced nozzles. Weldolets are manufactured in all sizes from 36" and all weights from xxs, in carbon steel, stainless, alloy, wrought iron and non-ferrous metals.

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ALLENTOWN, PENNSYLVANIA DEPT. A

expressing individuality by varying sizes of windows and doors by a few centimeters."

Stressing that lost time is lost money, Tuttle told of a French housing project where good materials and good workmanship were being used. When shown the four-year contract, Tuttle pointed out that the work should be finished in two years.

"You are right," the French contractor told Tuttle, "but money has been funded to be spent over a four-year period." The men were working for six months, then closing down for an equal amount of time. Experienced workmen got other jobs each time work was stopped and never returned to the project. Machinery was deteriorating.

Tuttle also told of Turkey's need for cement. "Five years ago, she authorized the construction of 13 plants. Today, one cement plant is nearly finished and in limited operation. The other 12 are in varying stages of completion, waiting for foreign exchange to release equipment from manufacturers in Europe and America.

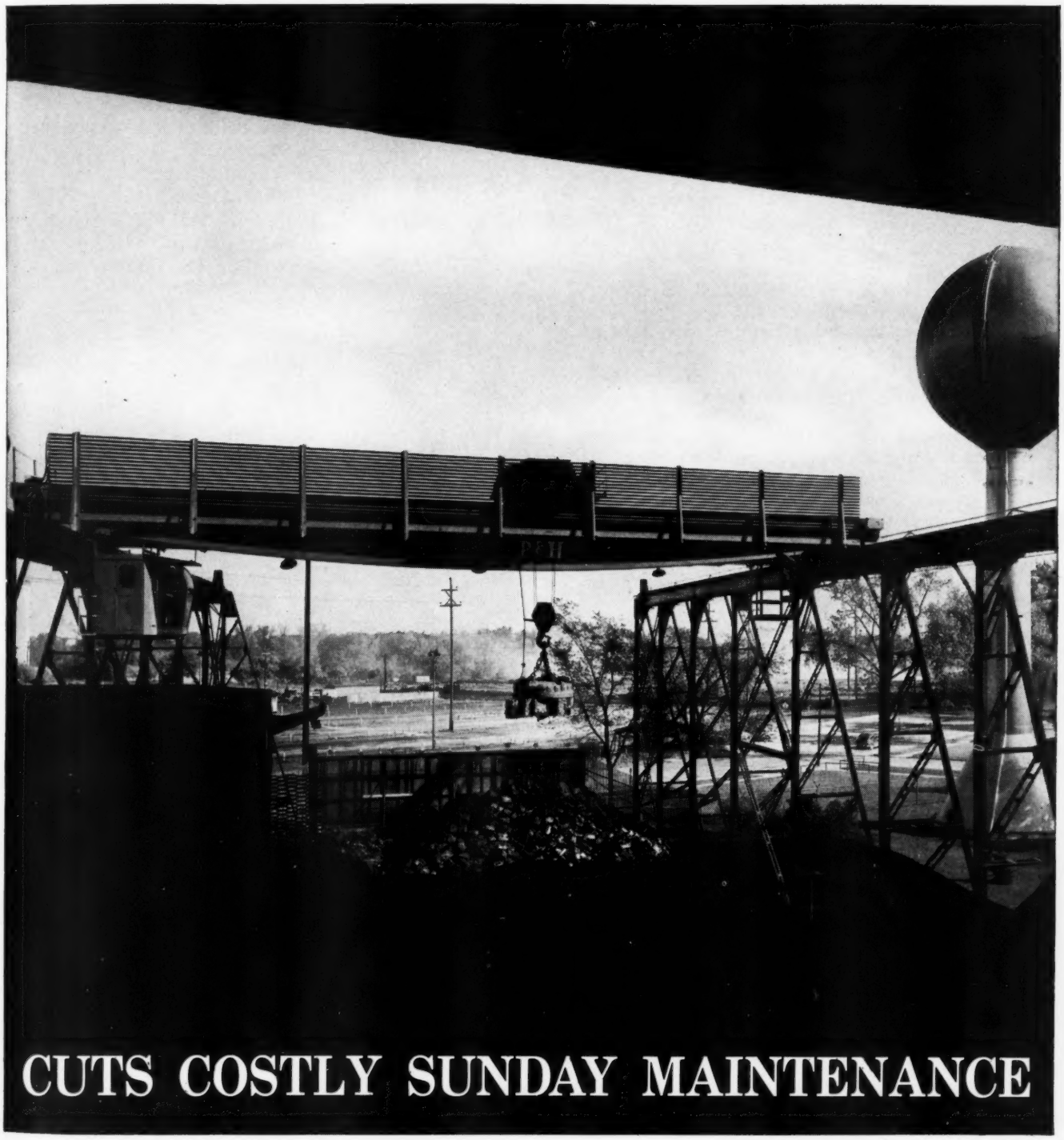
"Realistic fiscal management could have made it possible to place them in operation successively, and the country could have had the benefit of a steadily increasing supply of cement."

He concluded by telling the Danish engineers how "people all over the world are demanding better living conditions . . . An enlightened design profession can lead the way to that goal in a more orderly fashion, and with greater assurance of sound design than a miscellany of opportunistic and willing manufacturers (can) . . . But it cannot be accomplished by the methods of Michelangelo or Sir Christopher Wren."

Pipelines Near Completion

The *Israel Digest* reports that two oil pipelines — one from Haifa to Tel Aviv and the other from Eilat to Beersheba — are nearing completion.

The Haifa pipeline will take refined petroleum products from refineries to Tel Aviv. The other pipeline will be used to transport crude oil, which then will be taken from Beersheba to Haifa by rail.



CUTS COSTLY SUNDAY MAINTENANCE

Revolutionary P&H development . . . Electronic "stepless" crane control . . . eliminates 60% of wearing parts

Maintaining your cranes on Sunday to avoid production-line interruptions during the week is expensive, isn't it? P&H electronic crane control is the answer to that problem.

P&H electronic crane control is an outstanding new crane development, exclusive with Harnischfeger, and proved in over 300 installations. It's a simple wiring circuit that eliminates over 60% of the wearing parts found on previous crane controls — the wearing parts that need most frequent replacement.

Electronic control not only reduces maintenance, it furnishes "stepless" control response, making possible infinitely variable—more sensitive—crane operation. What's more, this major improvement can be applied to any existing AC crane.

Make sure your next overhead crane inquiry specifies this revolutionary crane development — P&H Electronic Control. Write Dept. 107F, Harnischfeger Corporation, Milwaukee 46, Wisconsin.

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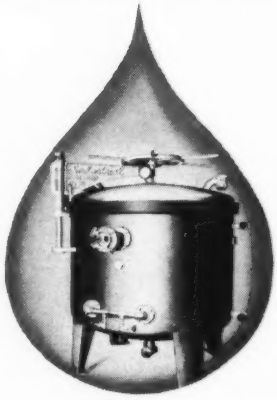
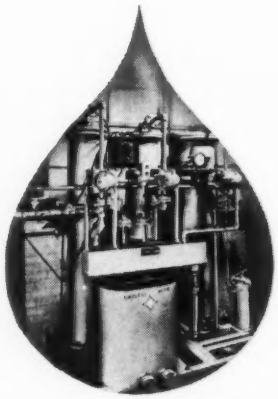
Water Problems?

Industrial can help you decide which kind of water treating equipment will best satisfy your clients' needs.



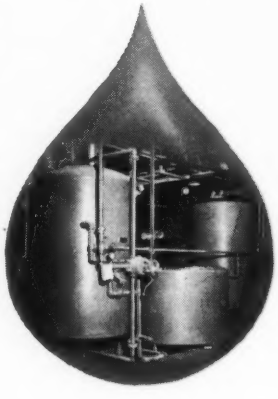
First of all . . . Industrial builds all kinds of water treating equipment. This means that our Water and Waste Treatment Division can recommend **without partiality** the most efficient and economical unit your client can use. Second . . . this division is staffed with **C.E.s** and **M.E.s** so your specification is backed by a competent chemical analysis and **the recommended design is thoroughly engineered** to cover all chemical and mechanical factors. Finally . . . you'll find our equipment in most auto and appliance factories; in many chemical, textile, sugar and paper plants; petroleum fields and refineries—just about anywhere that purification of liquids is important.

Here are some logical applications of different kinds of equipment



Filtration for paper mill waste. This large Vertical Leaf Filter takes the sludge out of paper processing water. It is the most economical way for a New Jersey mill to avoid violation of anti-pollution laws. Industrial makes all kinds of filters, Horizontal, Vertical, Tubular, Hydra-Shoc. All can be adapted to complete automation and can be arranged with a host of rapid cleaning and convenience features.

Ion Exchanger purifies plating bath water. Many metal finishing operations (plating, painting, anodizing) require rinse water better than drinking quality. Minute amounts of mineral in these waters will cause stains in plating, pinholes in paint coats and retard pickling processes. This modern chemical device can up-grade quality, save labor and pay for itself in a surprisingly short time. This one is at work in the Sunbeam plant in Chicago.



Zeolite Softener prepares boiler feed water. This unit in an Indiana appliance plant prevents scale formation in boiler tubes by replacing calcium and magnesium ions with sodium ions. The water achieves "zero" hardness in one rapid pass through the exchanger bed. The unit is useful for washing operations, food canning, textiles and other processing affected by hard water.

Want detailed literature? Just a note telling us how you'll use the water will do.

Industrial

INDUSTRIAL

FILTER & PUMP MFG. CO.

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In conjunction with the pipelines, an oil terminal will be constructed in Tel Aviv. The terminal will be owned and operated by three firms that market petroleum products in Israel. The firms will provide the necessary funds.

David Ben-Gurion, Israel's prime minister, said the pipelines will carry about half of Israel's annual imports of crude oil.

Bombay Power Station

The Trombay Thermal Station, designed by Ebasco for the Tata Group of Hydroelectric Companies, has been put on the line.

Located on the outskirts of Bombay, the 50,000-kw station is the largest in India. The station will add substantially to the power supply of Bombay and to the industrial potential of the city.

Jamaica Grants Mining Rights

Reynolds Metals Company and its subsidiary, Reynolds Jamaica Mines, Ltd., have been guaranteed the right to mine in Jamaica for 99 years.

After more than two months of negotiations, the firm recently signed a contract with the Jamaican government establishing bauxite royalties and taxes for a period of 25 years.

Half of the royalty will be a fixed amount for 25 years, with the other half fluctuating in ratio to the price of aluminum pig in the United States. Walter L. Rice, president of the Jamaica subsidiary, said the fluctuation allows the parties to establish royalties over 25 years as contrasted with the five-year terms under which the company has been mining ore in Jamaica since 1952.

Coffer Dam Flooded

Spring rains caused the Zambesi River to rise to a dangerous level, rising above the coffer dam which had been built at the Kariba Project.

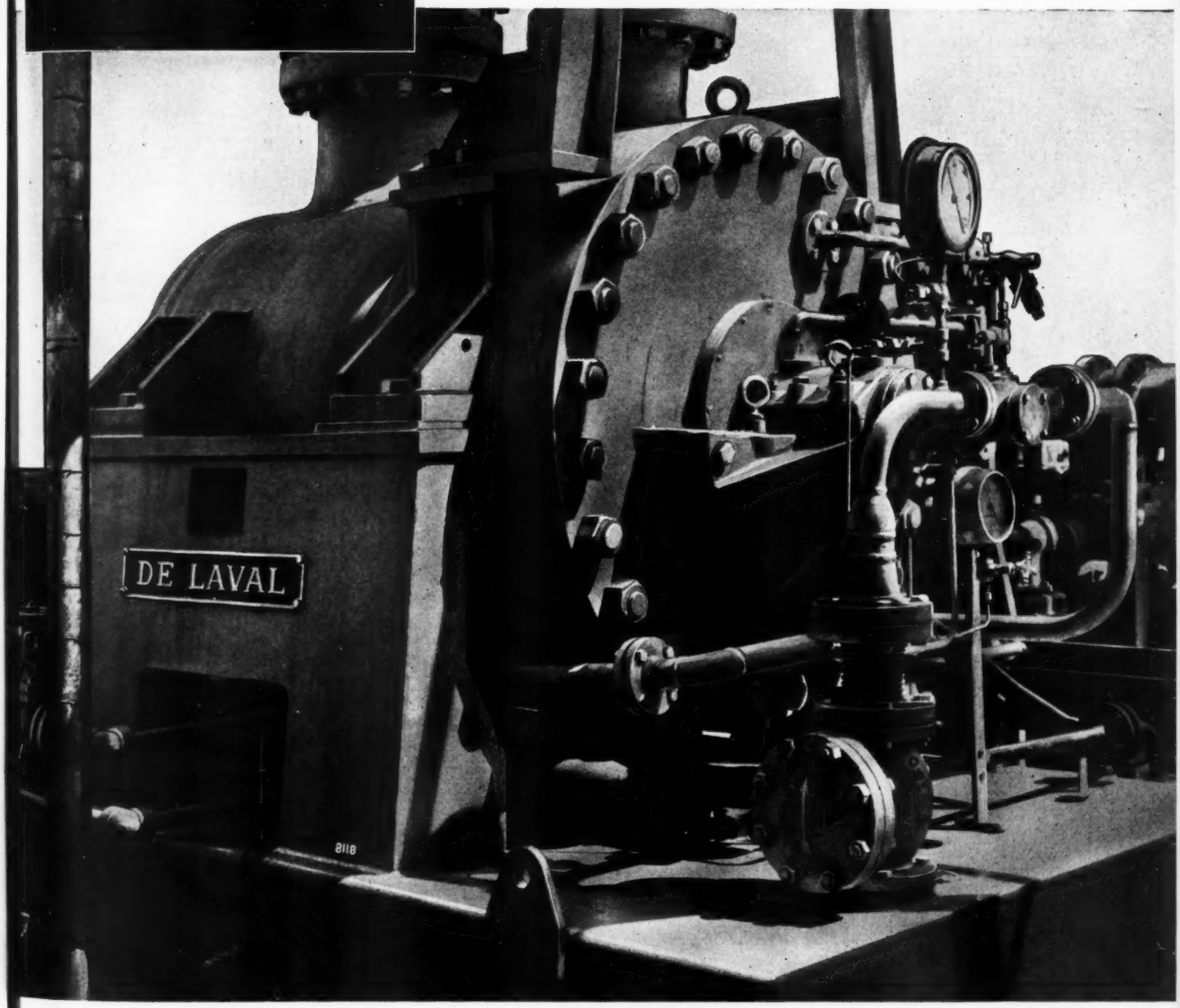
The 50-foot coffer dam was six feet below the 30 mile per hour torrent. The hillside roads, adjacent to the project, also were eroded.

Teams of workmen secured eight, two-in. steel hawsers from the bank pillars to the pillars at the center of a bridge, which it had

DE LAVAL

BARREL TYPE REFINERY COMPRESSOR

handles hydrogen under high pressures in a reformer at General Petroleum



Send for new Bulletin 0504

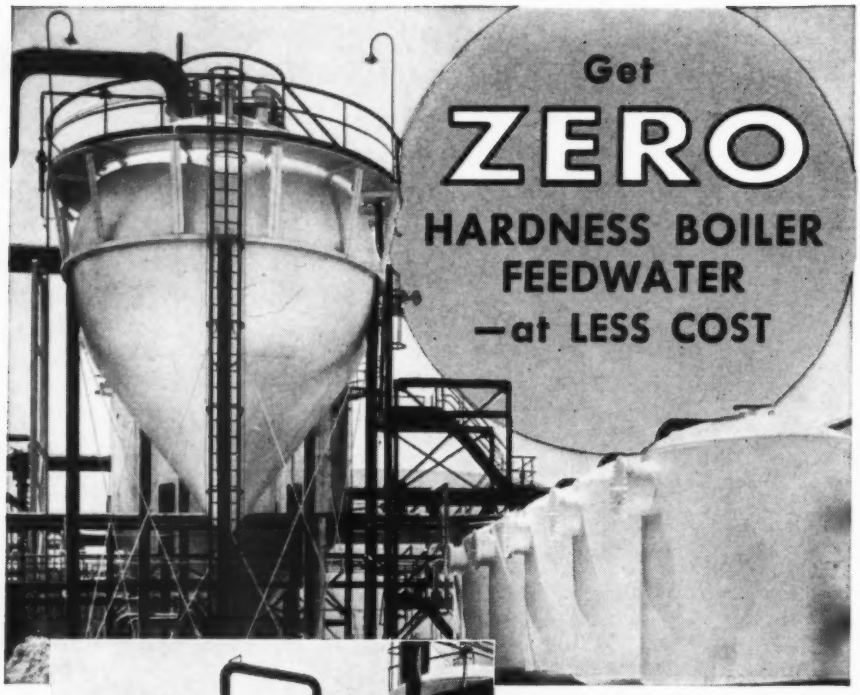
This De Laval centrifugal recycle barrel type compressor is doing a dependable job handling hydrogen under high pressures at the General Petroleum plant in Ferndale, Washington. It takes hydrogen at an inlet pressure of 500 psig and discharges it at 625 psig. The unit is driven by a 1110 hp turbine operating at 9900 rpm.

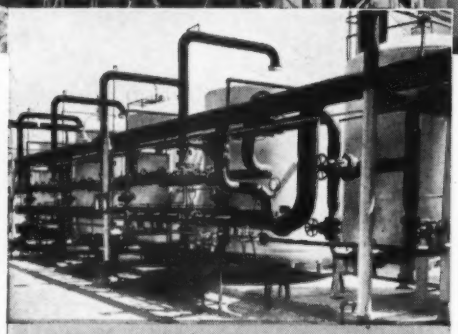
General Petroleum Corporation is only one of many refiners who have specified De Laval Compressors. Whether you need to handle light or heavy gases at high or low pressures in catalytic cracking, reforming, alkylation, coking or any similar service, it pays to look to De Laval. Rugged De Laval centrifugal compressors perform dependably in heavy-duty continuous operation. De Laval has more than 40 years of experience in solving gas compression problems.

DE LAVAL *Centrifugal Compressors*

DE LAVAL STEAM TURBINE COMPANY

894 Nottingham Way, Trenton 2, New Jersey





Top photo shows new outdoor hot lime-zeolite softener installation in a Southern refinery. Five Nalcite HCR ion exchange units (lower photo) have output of 470,000 gallons of zero hardness water between regenerations.

with
Nalcite® (DOWEX*) HCR
HOT LIME
ZEOLITE
TREATMENT

● Start with the simplicity of operation . . . add the low operating costs of hot lime-zeolite softening . . . all made possible by the outstanding high-temperature performance of Nalcite HCR in the zeolite softeners. Results: Zero hardness water, from virtually any raw water source, with a minimum of testing and control required. See your water treating equipment manufacturer for details on new or conversion hot lime-zeolite treatment for your plant . . . and for top softener efficiency, specify Nalcite HCR.

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Nalco® PRODUCTS

When you use Nalcite resins, you take advantage of Nalco's long and broad experience in water and process technology.

taken them 14 months to build. Other teams, stripped to the waist, hauled more than 100 tons of steel girders onto the bridge to give it added stability.

Special masses were held by the Italian workers at the scene, and apparently their prayers were answered. The bridge was saved.

Total cost of the Zambesi River hydroelectric scheme at Kariba, in Central Africa, is estimated at $340 million. The consultants on the project, Sir Alexander Gibb and Partners, London, A. Coyne and J. Bellier, France, S.O.G.E.I., France, have formed a combine called Gibb, Coyne, Sogei (Kariba) Pty, Ltd., with headquarters in Salisbury, Southern Rhodesia.

Olympic Stadium Restoration

The Olympic stadium, at Athens, Greece, could be restored to its 4th century, B.C., splendor for an estimated $60,000, according to reports of a group of German consulting engineers.

The funds, to be contributed by interested nations, would include rehabilitation of the track and one modern innovation — a drainage system.

Dry Dock

The Howaldtswerke, of Kiel, Germany, has blueprinted a dry dock to build super tankers up to 100,000 dwt, mainly for foreign customers. Six 65,000-dwt super tankers already have been ordered for delivery to overseas petroleum shippers.

Germany Feels Engineer Shortage

More than 32,000 additional engineers are needed for the electrical engineering and machine building industries in the German Federal Republic, according to a survey made by the technical education division of the Bavarian government. The number of employed engineers at present is 264,417, of whom 74,741 are certified engineers.

Shell Auditorium

The Frederick Mann Auditorium, resembling a fan-shaped shell, is nearing completion in Tel-Aviv.

Seating about 3000 persons, the auditorium features a hanging

"We ran this ad 6 years ago"

Save with SAFER... SURER AB BREAKERS
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NOTICE
ONE OF 2500 WESTINGHOUSE CIRCUIT BREAKERS INSTALLED IN THE GULF BLDG., PITTSBURGH

24
~~18~~ YEARS OF CONTINUOUS SERVICE
without failure, replacement or maintenance

2500 thermal-type branch circuit breakers, installed and then forgotten, in the Gulf Building, Pittsburgh, Pa., have written an unparalleled story of circuit protection. B. E. Moore, Building Superintendent, reports that after 18 years of service without failure, replacement or maintenance, these breakers were recently checked in random tests and were found to be "as good as new". On both overload and short circuit protection, they performed precisely to their original specifications. And on inspection, mechanical parts and contacts were found to be in "excellent condition". What better proof can we give you that when you install Westinghouse Circuit Breakers you install the finest in dependable, grief-free equipment. They are miserly with maintenance time, too—when trouble is cleared from the circuit, a flip of the breaker handle restores power instantly. No running after fuses, nothing to replace, nothing extra to buy.

For assistance on any circuit protection problem, contact your nearest Westinghouse office, or write for Bulletin No. DB-29-060, Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pa. J-30049

We still say...

only circuit breakers are so trouble-free

fuse replacement can be costly in outages and labor

YOU CAN BE SURE... IF IT'S

Westinghouse

TIME AND EQUIPMENT SHOULD NOT BE "EXPENDABLE"

by H. D. Dorfman

Westinghouse Electric Corporation

As a designer of circuit breakers, I frequently listen to the age-old argument that "...fuses are expendable; we can afford to throw them away".

This point of view can be costly. Experience has taught maintenance men that the protection of circuits with fused devices is not a positive insurance against down time or damage. Important reasons for the better protection afforded by breakers are:

A. When one faulted fuse in a three-phase operation "blows", the other two may stay in. Costly damage can result when this causes single-phase operation. What this does to maintenance costs, as well as production continuity, is plain. An AB breaker opens all three lines when any one is faulted.

B. Accurate calibration of a circuit breaker assures its operating at exactly the rating for which it is installed. Without this accuracy, circuits may be opened due to harmless surge currents, or may remain "live" beyond the point of safety. In the one event, we have unnecessary stoppage; in the other, probable repair costs.

C. In either event, restoration of service is a matter of seconds with a circuit breaker, in contrast to the time involved in locating and inserting fuses.

Suggests Checks on Quality

In my position as a design engineer, I am required to analyze our customers' experience with breakers under all kinds of operating conditions. I find customers served 20 and more years by the same AB breakers, more the rule than the exception. Based on this experience, I would advise anyone installing protective equipment, first of all, to make it circuit breakers. Beyond that, look for these specifications in order to get the most reliable protection with lowest maintenance potential:

Arc-quenching must be fast and free from flashover. The De-ion® principle is a good example, as it will extinguish an arc in less than ½ cycle. Insist on silver alloy contacts for low resistance and long life. The contacts we use have been proved "non-welding" by extensive tests.

Plating of parts can spell the difference between breaker "sudden death" and longevity. Westinghouse even plates internal copper parts of circuit breakers to assure long life where corrosion elements may attack. Make sure your breaker has a trip latch that is heat-treated after grinding and polishing. Specify a quick-make, quick-break mechanism of the over-center toggle type for utmost reliability where breaker duty is severe.

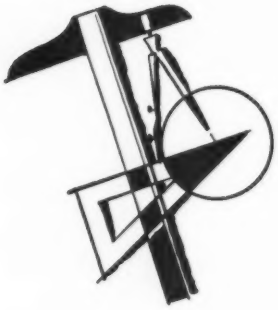
If all of these points are checked "yes" on the breakers you choose, you will be providing yourself with the best that electrical engineering has developed so far. J-30258

CORROSION PROBLEMS SOLVED...COMPLETELY

Tanks . . . Floors . . . Fume exhaust systems . . . anywhere in your plant where corrosion can cause lost time and money, Atlas is prepared to offer their complete service. From on-the-spot technical advice through enginering design to complete construction facilities to carry the job from beginning to end, Atlas can help you with your corrosion problems.

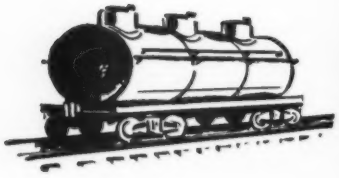
ON THE SPOT TECHNICAL ADVICE

Representatives located in major cities throughout the United States will call at your plant, look over your corrosion problems and prepare suggestions for solving them.



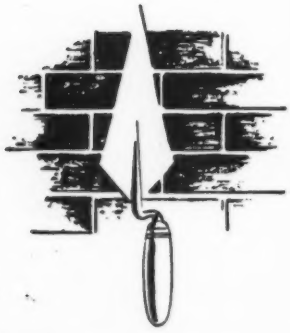
ENGINEERING DESIGN

Engineering facilities at the Atlas home office are geared to provide recommended design features, based on a quarter century of experience in the field.



HIGHEST QUALITY MATERIALS

Atlas time-tested corrosion proof materials of construction are your assurance of long term service. The controlled manufacture of Atlas materials maintains the highest standards of quality.



COMPLETE CONSTRUCTION FACILITIES

The most complete corrosion proof construction facilities available are maintained by Atlas. Shop and field fabrication, installation and follow-up service assures you of complete interest in your problems.

Write for your copy of Atlas Bulletin CC#3 containing informative data on the complete Atlas line.

ATLAS MINERAL PRODUCTS COMPANY
MERTZTOWN, PENNSYLVANIA

ceiling and a roof supported by trusses based on cylindrical bearings to allow for expansion and retraction resulting from temperature fluctuation.

Soviet Coal Pipeline

A Soviet coal industry trade journal says that the Russians already have developed a hydraulic system for transporting coal under high pressure in steel pipelines three to five miles long.

Applicable for use in mines as deep as 1900 feet, the pipeline was developed by the central research bureau of the Ministry of the Coal Industry, USSR.

"The way now is open for employing pipelines to ship coal from the mine heads to steel mills; coke, chemical, and gas works; electric stations; and other consumers at distances of 100 to 133 miles," the Russian author concluded.

British Use Water As Coolant

A large generator, scheduled to be installed in Britain, will be cooled by distilled water.

The conductors will be hollow, with the coolant forced through. The 30,000 kw generator is said to be the first to use distilled water as a coolant.

Shell Roofs Economical

Italy has come up with a new method of building shell roofs, based on the use of prefabricated brickwork units.

Shell roofs on industrial buildings, sheds, and other such structures have a thickness that is negligible when compared with the surface area. However, waste timber used in preparing the formwork and shuttering for prefabricating the brickwork makes this type of roof expensive.

Instead of formwork, this method makes use of widely-spaced shoring. The units are made of hollow bricks, similar to those ordinarily used for floors. The bricks are sloped at an angle of 30 degrees on each end, and laid in a row for the length required. The reinforcing then is mounted, using normal rods as well as special brick bars placed in the space within the upper groove and between the bricks. The grooves then are seal-

MARLEY IS STILL TESTING TOWERS

Here are the current results—a consecutive list of **ALL** acceptance tests conducted by Marley during 1956 on Cross-Flow industrial towers. Although towers tested were of many sizes and capacities, operating under varying conditions and in various parts of the country, there is one "common denominator" in all the tests—the positive performance of Marley cooling towers. Better than words, better even than written guarantees, these tests are your assurance of complete performance satisfaction when you purchase a Marley cooling tower.

The Marley Company has long pioneered the policy of "test your tower," for we believe that every purchaser is entitled—if not obligated—to know the performance of his tower in exact and authoritative terms. We also believe that every prospective purchaser is entitled to know the performance record of Marley towers, and for this reason have consistently published the results of Marley's own tower-testing program.

If you'd like to know the Marley method of measuring performance of cooling towers, regardless of make or vintage, we invite you to write for our technical publication, "TEST YOUR TOWER."

TEST NO.	TYPE OF SERVICE AND LOCATION	SPECIFIED CONDITIONS				TEST RESULTS	
		Gallons Per Minute	Hot Water Temp.	Cold Water Temp.	Wet Bulb Temp.	Degrees Cold Water Temp.	Percent Capacity
1	Generating Station—North Central	49,200	100.8°	85°	74°	+.26°	+2.3%
2	Generating Station—Southwest	28,000	99.5°	83°	74°	+.15°	+1.5%
3	Chemical Plant—East Coast	33,000	105°	86°	81°	+.43°	+12.7%
4	Generating Station—Mid-West	62,400	107.5°	90°	76°	+.02°	+.13%
★5	Petrochemical Plant—Mid-West	10,000	105°	83°	76°	—.25°	—2.14%
6	Petroleum Refinery—Mid-West	8,500	120°	85°	76°	+.15°	+1.35%
7	Generating Station—Mid-West	26,000	110°	91°	75°	+.70°	+3.4%
★8	Petroleum Refinery—Gulf Coast	21,000	113°	90°	80°	—.45°	—2.85%
9	Petrochemical Plant—Gulf Coast	6,000	105°	85°	80°	+.06°	+.69%
10	Petrochemical Plant—East Central	21,000	120°	85°	73°	—.2°	—1.5%
11	Generating Station—Southwest	38,700	93°	78.5°	65°	—.4°	—2.15%
★12	Generating Station—North Central	7,180	101°	87°	74°	+.1°	+.77%
13	Generating Station—East Coast	26,400	96°	86°	79°	+.30°	+4.17%
14	Petroleum Refinery—Mid-West	8,000	120°	84°	74°	+.70°	+6.4%

★ Tested in accordance with Cooling Tower Institute test procedure ATP-105 and observed by CTI representative.

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The Marley Company

Kansas City, Missouri

Technical Services Dept., 212
The Marley Company
222 W. Gregory Blvd.
Kansas City, Mo.

Please send me a copy of your brochure, "TEST YOUR TOWER."

Name.....

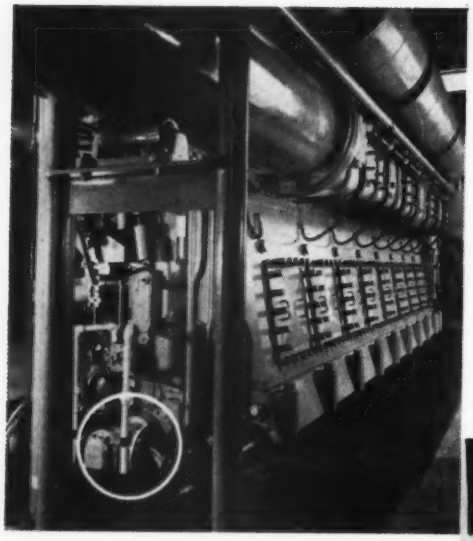
Firm.....

Address.....

City.....State.....

Sier-Bath "GEAREX"® ROTARY PUMPS

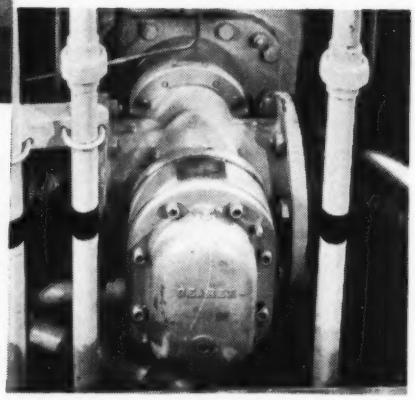
prove their reliability and economy at



NATCHITOCHES (La.) POWER PLANT

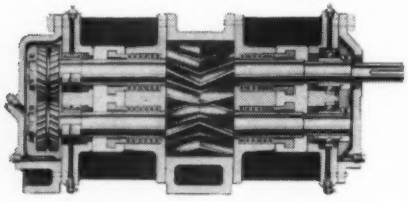
•

Operating 2 years in vital lubricating oil circulation, without need for maintenance.

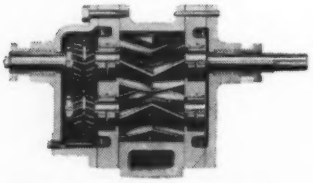


● Two engines of the type shown above, are in operation at the City of Natchitoches Power Plant, each running 12 hours a day, 3½ days a week. Based on past successful experience, the engines were equipped with Sier-Bath "Gearex" Rotary Pumps to circulate SAE 40 lubricating oil at 120-130°F. Installed over 2 years ago, the "Gearex" Pumps have given uninterrupted service, required no down-time for maintenance or repair, continue giving trouble-free, dependable pumping.

***Sier-Bath* "Gearex" Pumps**



EXTERNAL GEAR & BEARING TYPE
for non-lubricating liquids



INTERNAL GEAR & BEARING TYPE
for lubricating liquids

Sier-Bath "Gearex" Pumps provide positive displacement, pulseless flow . . . quiet, vibrationless operation. Direct-connected up to 1800 RPM, they require no reduction gears. For sustained high volumetric efficiency and long life there is no rotor-to-rotor or rotor-to-casing contact. Low pressure on stuffing boxes provides easy servicing.

Horizontal or vertical models to handle 32 to 500,000 SSU, 1 to 550 GPM at 250 PSI for viscous liquids, 50 PSI for water. Corrosion-resistant alloys, steam-jacketed bodies, water-cooled bearings, other adaptations to meet individual needs. Call your local Sier-Bath Pump Representative . . . send for Bulletin G-2. *Sier-Bath Gear & Pump Co., Inc., 9257 Hudson Blvd., North Bergen, N. J.*

Sier-Bath ROTARY PUMPS

Screw Pumps | Gearex® Pumps | Hydrex® Pumps

50th Anniversary | Mfrs. of Precision Gears, Rotary Pumps, Flexible Gear Couplings | Member A.G.M.A.

ed and bonded with cement mortar.

These beams can be prefabricated either in a straight or a curved line. The units are raised and positioned parallel on provisional shoring to form a surface having longitudinal and transverse channels in which additional reinforcing bars can be placed to form a grid. The concrete then is poured in the channels and the structure becomes a single block.

This method, devised by an Italian engineer, already has been used on buildings in Argentina and in Italy.

Russia Captures Sun's Rays

Reports from Russia say the sun's rays, captured by a giant circle of mirrors, will produce 1200 kw of electric power in a solar power station planned for the Ararat plains in Armenia.

Details of the power station were published in the Soviet Literary Gazette.

More than 1000 large mirrors will revolve automatically to follow the sun's rays. In the center, a 130-ft tower will support a revolving boiler.

The sun's rays, directed on the flat wall of the boiler, will heat water, generating steam that will be sent by pipes to a turbo-generator. The entire plant will be switched on by photo-cells at dawn. Power from the station will be used to irrigate fields in the nearby plains.

Canada Plans New Airports

With a number of new airports, and others under construction, Canadian Transport Minister George C. Marler has announced plans for additional airport terminals and facilities.

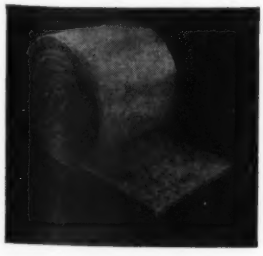
During the past 10 years, Canada has spent an estimated $200 million to meet the needs of present and prospective aviation. New terminal buildings have been constructed at Moncton, Saskatoon, Seven Islands, the Lakehead, Comox, and Sandspit.

Terminals are nearing completion at Quebec City, Windsor, Stephenville, and St. John's Nfld.

Marler said "the Department of Transport, in addition, has three very large projects on which construction is progressing. These involve an aggregate outlay of about $20 million. Plans are being de-

GULFGATE SHOPPING CITY, Houston
Architect: John Graham, Seattle
General Contractors: Farnsworth and Chambers
Insulation Contractor: Precision Insulating Co.

Whopping shopping center goes for GUSTIN gb BACON GLASS FIBER INSULATIONS...



. . . because G-B insulations are a step ahead in thermal and acoustical efficiency, in ease of application, and in lasting performance. At the world's largest shopping center — and in commercial, institutional and industrial construction everywhere — the first call is for these superior G-B products:

ULTRALITE DUCT LINER, the long glass fiber insulation specifically designed to silence objectionable noises in air conditioning systems — and an excellent thermal insulation in the bargain.

ULTRALITE DUCT INSULATION, the long glass fiber insulation that is superior in thermal efficiency . . . tougher and more resilient . . . easier and cheaper to apply.

G-B SNAP*ON, the popular one-piece pipe insulation molded of fine glass fibers. Snap*On is not only superior in thermal efficiency to *any* general-purpose pipe insulation on the market, but also far easier and cheaper to apply because 3-foot sections snap on the pipe in less time than it takes to say "Snap*On"!

FOR INFORMATION AND PROMPT DELIVERY CALL YOUR
LOCAL G-B INSULATION DISTRIBUTOR OR WRITE FOR COMPLETE INFORMATION

GUSTIN-BACON *Manufacturing Company* GUSTIN gb BACON

Thermal and acoustical insulations • Molded glass fiber pipe insulation • Pipe couplings and fittings

212 W. 10th St., Kansas City, Mo.

Meet the "Little Brother"

. . . he's New in the Warren family

Across the page . . . we present little TS*, the latest addition to the popular line of Warren Screw Pumps.

Like his big brother, IGAB**, he'll lift any noncorrosive liquid—up to 450 lbs. (IGAB goes about 1200 lbs.) And TS is ideal for *heavy* fuel oil services.

He's easy to take care of, too . . . like replacing the rotor by simply sliding a new one through the rear head. No adjustment is necessary.

And best of all—TS will do the job for half the price!

When you have a problem that can be handled by a smaller pump, consider this efficient little Warren TS. It saves on costs, takes up less space, is easy to maintain and guarantees the same pumping satisfaction of all experience-rated WARREN PUMPS.

*Twin Screw
**Internal Gear And Bearing (Quadruple Screw)

WARREN PUMPS, INC., Warren, Mass.

WARREN

G-5

veloped for other terminals which will be built when circumstances make it seem more expedient."

To Harness Seapower

Construction of a tidewater power plant, to get electricity from sea power, is scheduled to begin soon in the Rance estuary, Brittany. The project was designed by French engineers.

Specifications call for a combined dike and power plant 2300-feet long, through which huge masses of water will pass at each tide. The plant will have 38 bulb groups of 9000 kw, with power fed to the general network at 220,000 volts.

The French plan to have 8 to 10 groups functioning by 1960, with 8 to 10 additional groups completed by 1962. The entire plant is scheduled to be in operation by 1963, with an annual production of 800-million kwh.

Polish Coal Insufficient

The Polish radio reports nuclear power plans are being rushed because of the failure of the Polish coal industry to provide sufficient fuel.

Coal exports have decreased from 50-million tons annually five years ago to 12-million tons last year. The rapid increase in the demand for electric power cannot be met with conventional fuels alone. "Nuclear power is our only alternative," the Poles explained. By 1980, Poland plans to have half of its power demands supplied by the atomic reactors, thus saving 40-million tons of coal annually for export.

The first Polish nuclear power station is to be commissioned in 1965. This reactor is to be fueled with natural uranium, and differs from the Soviet reactors in that it will be graphite moderated and gas cooled. This station also would produce plutonium for enriching the fuel of later reactors.

French Complete African Bridge

The Baddrift Bridge, on the Vaal River, South Africa, recently was completed by the *Societe African Batignolles Constructions*, South African branch of the *Societe de Construction des Batignolles.*

The 720-ft bridge is 26 feet wide, with seven reinforced concrete arches resting on pillars set directly on rock. Temporary coffer dams of metal sheet piling protect the pillars.

New Surveying Instrument

A new electronic surveying instrument has been introduced in England by Cooke, Troughton & Simms in conjunction with Tellurometer Ltd. of Cape Town, Africa.

Called the Tellurometer, the instrument eliminates the need for measuring with tapes, and is reported to be more accurate than optical range finders.

Working range of the new instrument is from 500 feet to 35 miles. The only requirement is that the line be unobstructed by a solid object.

The measuring instrument measures the travel time of radio waves with an accuracy of a fraction of a millimicro-second. A master station and a remote station are needed. Both are portable, self-contained units with built-in aerials.

The new device is handy for use in bush or flat country, where the instrument can be set on raised structures which need not be as rigid as those needed for a theodolite. It also is expected to be used in hydrographic and aerial surveying.

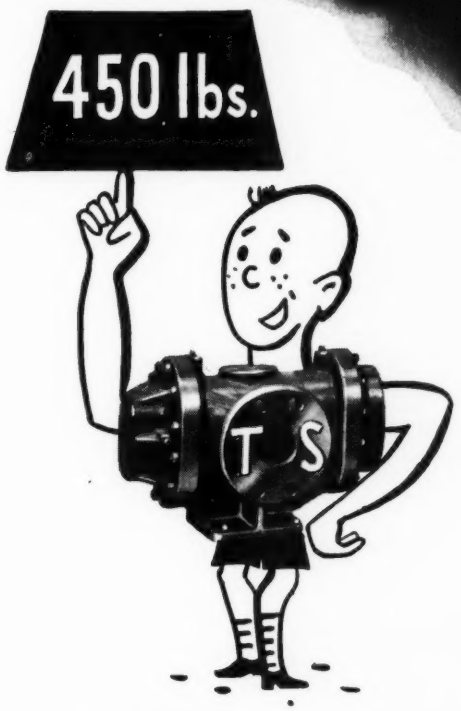
New Canadian Bridge

Contract has been awarded for the second largest cantilever bridge in Canada. The $11,099,672 six-lane bridge will cross Burrard Inlet at Vancouver. Swan, Wooster and Partners are consulting engineers on the project.

In conjunction with a proposed express highway, the bridge also will serve as a bypass of Vancouver and New Westminster for through traffic to Horseshoe Bay.

With a center span of 1100 feet, the Second Narrows bridge will contain 16,600 tons of steel. High strength bolts, instead of rivets, will be used for field connections.

The 3160-ft superstructure will consist of four deck truss spans on the north approach, each approximately 282 feet long, and a main 1100-ft span flanked by two 465-ft anchor spans.



I'm "Little Brother TS"

... the *newest* Warren Screw Pump

TS* is the name. And just compare TS's capabilities with big brother IGAB's:**

	TS	IGAB
Capacity	to 600 gpm	to 4000 gpm
Pressure	to 450 psi	to 1200 psi
Viscosity	to 150,000 ssu	to 150,000 ssu
Speed	to 3000 rpm	to 1750 rpm

There are many pumping jobs that Warren's dependable little TS can do just as well as a pump costing twice as much. Get all the details now. Just fill out and mail the coupon below.

*Twin Screw
**Internal Gear And Bearing (Quadruple Screw)

G-5A

WARREN PUMPS, INC., Warren, Mass.

Gentlemen:

Please send me complete information on "TS"—Warren's newest screw pump.

Name and Title.....

Company.....

Address.....

City.....Zone.....State.....

☐ PLEASE HAVE YOUR REPRESENTATIVE CALL.

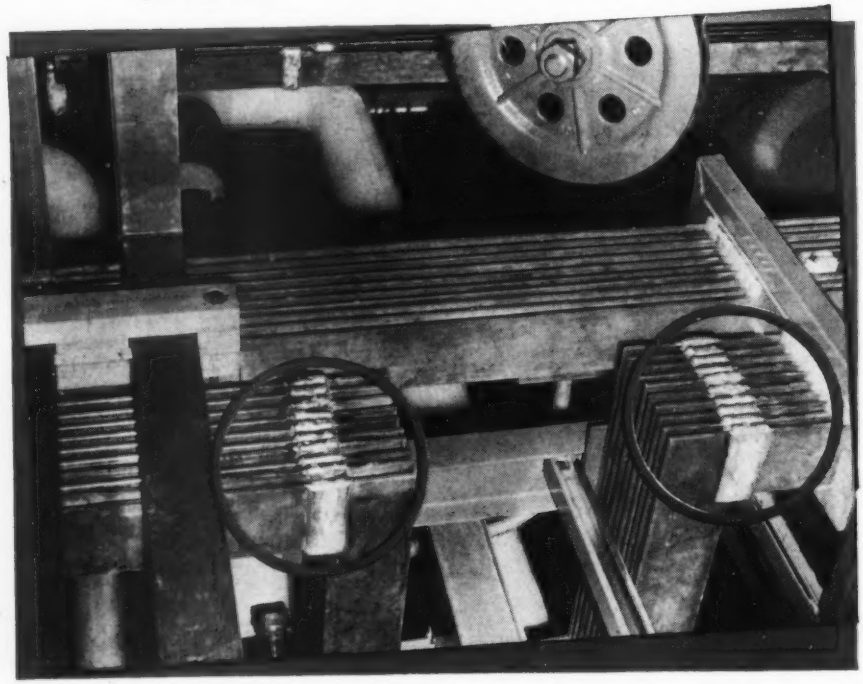
GENERAL ELECTRIC

endorses Contractor's use of

CADWELD®

electrical bus bar connections

HATFIELD ELECTRIC CO., INC., nationally-known electrical contractor recently completed an electrical bus bar installation for the GENERAL ELECTRIC COMPANY at Louisville, Kentucky. CADWELD ELECTRICAL CONNECTIONS were used on the ½ x 3 and ¼ x 4 bus bars that feed the GENERAL ELECTRIC plating tanks.



HATFIELD and GENERAL ELECTRIC were completely satisfied with their first experience with CADWELD on a multiple bus installation. Both companies have been using CADWELD for grounding connections for over five years.

Before figuring your next bus installation, investigate **CADWELD.**

CADWELD®

Erico Products, Inc.

2070 E. 61st Place Cleveland 3, Ohio

IN CANADA: ERICO INCORPORATED, 3571 Dundas St., West, Toronto 9, Ontario

Bridge Plus Sound Effects

The Bridge Commission, at Port Huron, Mich., had a nerve-wracking day recently, with dozens of motorists reporting that the Blue Water Bridge was falling down.

The bridge, which joins Port Huron and Sarnia, Ontario, was making loud popping noises.

Investigating, the Bridge Commission found that the large bolts connecting the soleplates of the deck girders and the bronze plates of the bridge columns were contracting and expanding with temperature changes.

Friction, resulting from the bearing surfaces being rubbed together, was causing the "popping."

Grease was applied — the noise continued.

"Dag," a colloidal dispersion of graphite, was applied to the joints to lubricate the bolts within wide temperature ranges.

The noises stopped, and have not resumed.

Announce Three Projects

Three most recent projects, announced by *Imprese 'Italiane all' Esters*, of Italy, include:

Canicada, Portuagal—construction of the discharge tunnel of the hydroelectric works, $3,700,000.

Egypt — mechanical, construction, road-building, and port facilities contracts for more than $20 million.

Nigeria — public works, factory, and road-building projects at a cost of $5,800,000.

Pipeline Ahead of Schedule

A 300-mile section of the Trans-Iranian pipeline has been completed four months ahead of schedule. The pumping stations and pipeline were built by a British company.

The Persian pipeline lies across the Khuzistan plain, through the Kashgan River gorge, and over the Zagros mountains at a height of 7000 feet. Cost was $18 million.

Coal Utilization Plant

The Joint Coal Board, which has charge of all coal mining in North South Wales, Australia, is discussing the possibilities of constructing a coal utilization plant at an estimated cost of $120 to $180 million. ▲▲

INSIDE STORY:

Why a Heat Exchanger Poses for an X-ray

This technician is giving a clean bill of health to a completed weld on a P-K heat exchanger. Like the x-ray of your chest, this x-ray picture is designed to pick up flaws before they have a chance to become harmful.

Pinholes, lamination, slag inclusions, and all other symptoms of failure are ruled out by this process, which is used to scrutinize the "inside" of *every weld*. Such radiographs are indispensible in manufacturing pressure vessels that will meet every test of time and use. Each x-ray is checked by a representative of the Hartford Steam Boiler Inspection and Insurance Company —for further insurance that every P-K heat exchanger meets or exceeds the rigid standards of the 1952 ASME Code for Unfired Pressure Vessels.

But weld x-rays at P-K represent only a *precaution*. They don't speak for the fact that all P-K welders are ASME qualified for a total of more than 50 types of welding procedures—meaning that the likelihood that flaws will occur at all is minimized. Nor can you see in an x-ray photo the incredibly careful design and calculation that goes into every P-K pressure vessel, to assure that it will be *thermally* and *physically* correct in every way.

Add this all-important knowledge of thermal design to P-K's fabricating and testing procedures, and you have what makes P-K heat transfer equipment different —and better—than all the rest.

Like proof? We'd be delighted to receive your inquiry. The Patterson-Kelley Co., Inc., 1750 Burson Street, East Stroudsburg, Penna. Offices in principal cities.

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Twin Shell Blenders • Autoclaves • Pilot Plants • Heat Exchangers • Ribbon and Double Cone Blenders • Lever Lock Doors

News for the Consultant

ASEE, College Placement Groups Revise Recuiting Code of Ethics

Concerned that the great demand for engineering graduates will lead to excesses in college recruiting, the American Society for Engineering Education and the Midwest College Placement Association have joined to prepare a new code of ethics on recruiting practices and procedures.

The code says — in effect — that industry, colleges, and students must seek to be prompt, businesslike, and honest in their placement activities because of the temptations of today's keen demands for engineering graduates.

Employers should avoid "elaborate entertainment and overselling." There should be no "special payments, gifts, bonuses, or other inducements," nor should there be reward for a third party who may prevail upon a student to accept an employment offer.

On their side, students "should not hoard or collect job offers." When a student accepts an offer he should let other prospective employers know his decision and he should not accept additional interviews. Students invited to visit plants or company headquarters should decline unless "sincerely interested" in working for the company, and their expense sheets for such trips should include only expenses directly concerned.

The colleges can help, says the new report, by encouraging both students and interviewers to be businesslike, by discouraging "indiscriminate shopping," by competently advising (but not unduly influencing) students, and by giving interviewers complete information about graduating students.

The new code of ethics revises a March, 1949, publication of the American Society for Engineering Education. In a foreword to the new booklet, C. J. Freund, Dean of the College of Engineering at the University of Detroit and Chairman of ASEE's Committee on Ethics, says, "Industrial employers are actively competing for the services of engineering graduates. In the stress of competition some employers have developed procedures which appear improper to others, particularly those with longer experience in visiting colleges to interview seniors.

"We hope that some of the present difficulties may be overcome by the new code of ethics, adjusted to new conditions, in the same way that a previous publication was instrumental in solving similar problems of 1949," says Dean Freund.

Copies of the new "Code of Ethics, Recruiting Policies and Procedures," are available from the Secretary of the American Society for Engineering Education, University of Illinois, Urbana. Single copies are priced at 25 cents each; but substantial discounts are given for quantity purchases.

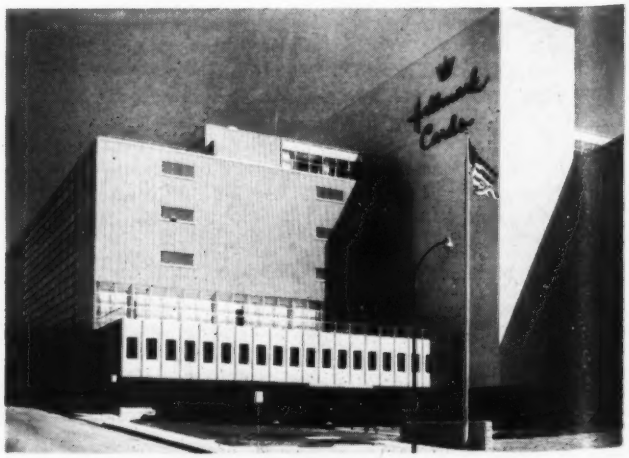
Complete New "Inverted Pyramid" For Hallmark Cards Headquarters

Hallmark Cards, in Kansas City, Mo., now is operating from a new building based on an inverted pyramid design. Architect and engineer for the project was Welton Becket & Associates, Inc., of Los Angeles, Calif.

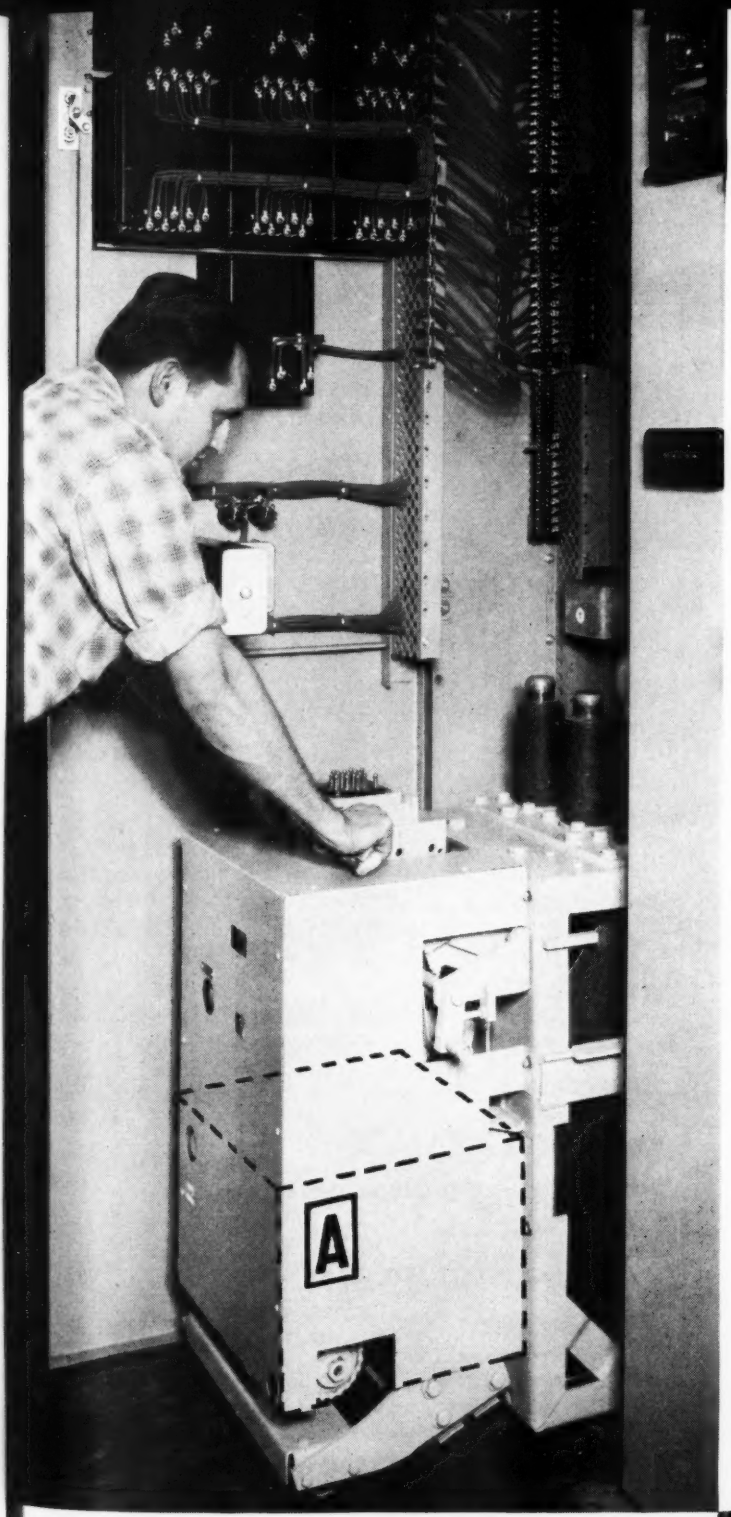
The only industrial building in the world with its smallest floor at the bottom and the larger areas above, the Hallmark building is arranged on uphill terrain so that every floor has a street level shipping and receiving dock. Production activities start on the upper floors, moving by conveyor belts toward the lower decks.

The central tower rises 11 stories, and contains elevators, a cooling tower for the air-conditioning system, and a 25,000-gal. tank for the sprinkler system. It is floodlighted at night.

Main entrance of the building faces a landscaped



NEW HALLMARK "INVERTED PYRAMID."



A 90% cut in control power for Metal-Clad Switchgear

A stored energy closing mechanism, latest of the engineering and design developments which make General Electric your most modern metal-clad switchgear buy, now offers you a 90% reduction in control power requirement. Magne-blast circuit breakers with interrupting ratings of 150 MVA or over are optionally available with this mechanism.

Here's what this feature can do for you:

1. Eliminates requirement for 125 volt or 250 volt metal-clad operating battery.

2. Simplifies control power distribution system.

3. No high current voltage drop problems.

4. Permits simultaneous closing of any number of breakers without the high current problem.

5. Omission of AC closing rectifier eliminates associated maintenance and operating problems.

6. Built-in feature provides for safer, faster, manual emergency closing in event of loss of control power.

For additional information on this optional feature, write to Section 511-25, General Electric Company, Schenectady 5, New York.

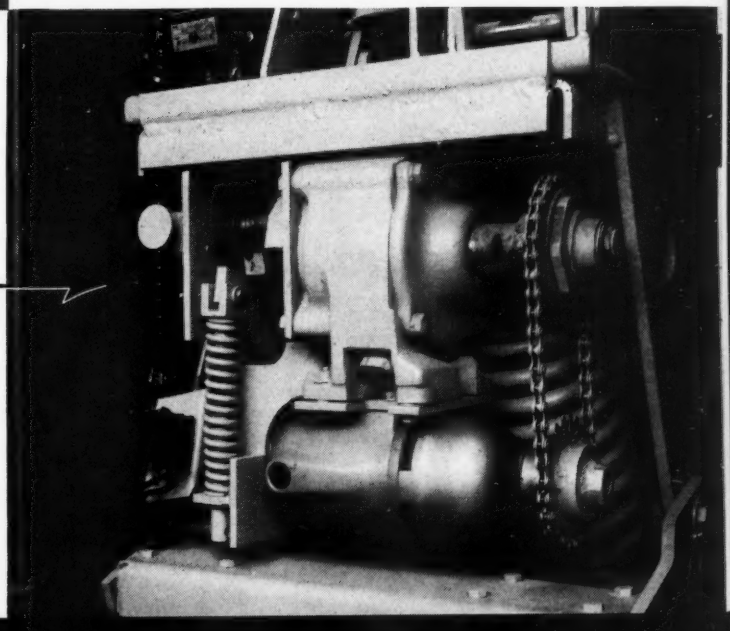
Progress Is Our Most Important Product

GENERAL ELECTRIC

IN ADDITION to the optional stored energy closing mechanism, General Electric Metal-clad Switchgear and Magne-blast breakers offer all the **PLUS** values of solenoid-operated equipment, such as **Self-X** insulation, and easy maintenance.

A

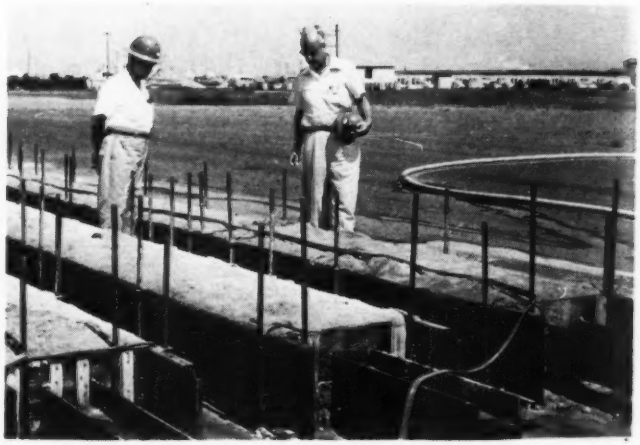
ENERGY IS STORED in powerful springs. To close a breaker, it is necessary to energize only a low-energy release coil with the control switch and the springs do the rest. The springs are recharged by a fractional horsepower gear-motor in a few seconds.



park with a circular drive that is heated in winter. An arcade, leading to the entrance, is decorated with 13 mosaic tile panels depicting, in calendar fashion, the seasons and major occasions of the year.

Two Worthington 750-ton centrifugal refrigeration units provide air conditioning for the entire building. The units also maintain the proper humidity and temperature controls to protect the paper stocks.

Air is distributed in the production and general office areas by 32 horizontally suspended air handling units containing chilled water coils and separate steam heating coils. The dining room is cooled or heated by a unit utilizing outside air, which is exhausted through the kitchen and dishwashing areas.



STEEL STREET FORMS DID DOUBLE DUTY.

Steel Street Forms Serve Dual Purpose

Steel street forms, commonly used for curb, gutter, and sidewalk construction, were used to form 500 concrete piles for a 2000-ft long quay wall at the relocation of the Minecraft Base, in Charleston, S. C.

G. M. C. Lucas, project manager for the contractor. said reports indicate a 66 percent savings in labor costs. The piles were poured into a standard Blaw-Knox steel street form on the job.

Relocation of the minecraft base began in July, 1956. Dedication of the $15 million project tentatively is set for this month.

The piles — 63 and 77 feet in length — are designed to support the quay wall, an artificial bank which projects into a section of the base's navigable water. The entire dock, which was precast, will provide a one-stop water-air-diesel fuel servicing point for naval mine-craft.

Fiberglas paper covered the asphalt coated area in which the piles were poured. After the steel forms were removed and the concrete piles water cured for 21 days with a perforated sprinkling hose, the Fiberglas covering prevented concrete from sticking to the pavement.

The mine company plans to use the steel street forms later to curb an asphalt roadway at the base.

IT PAYS TO HAVE HUBBELL QUALITY CONNECTIONS

and here's another NEW product

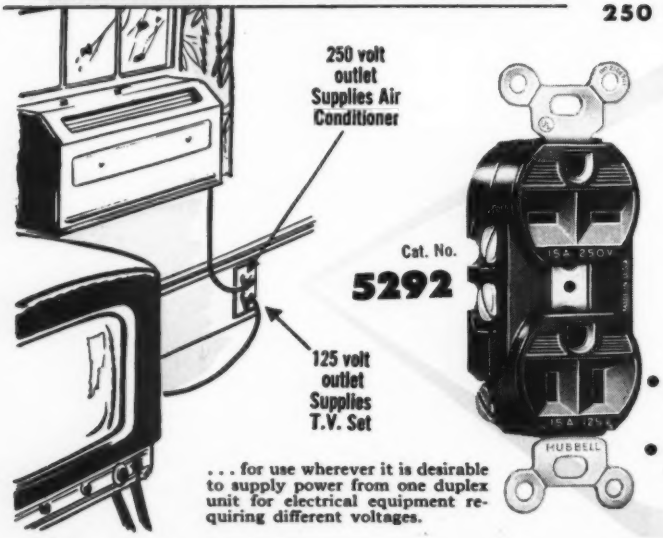
SOLD ONLY THROUGH AUTHORIZED ELECTRICAL WHOLESALERS

NOW . . . the convenience of a COMBINATION

3-wire 15 amp. GROUNDING TYPE

250 VOLT AND 125 VOLT DUPLEX RECEPTACLE

UL APPROVED

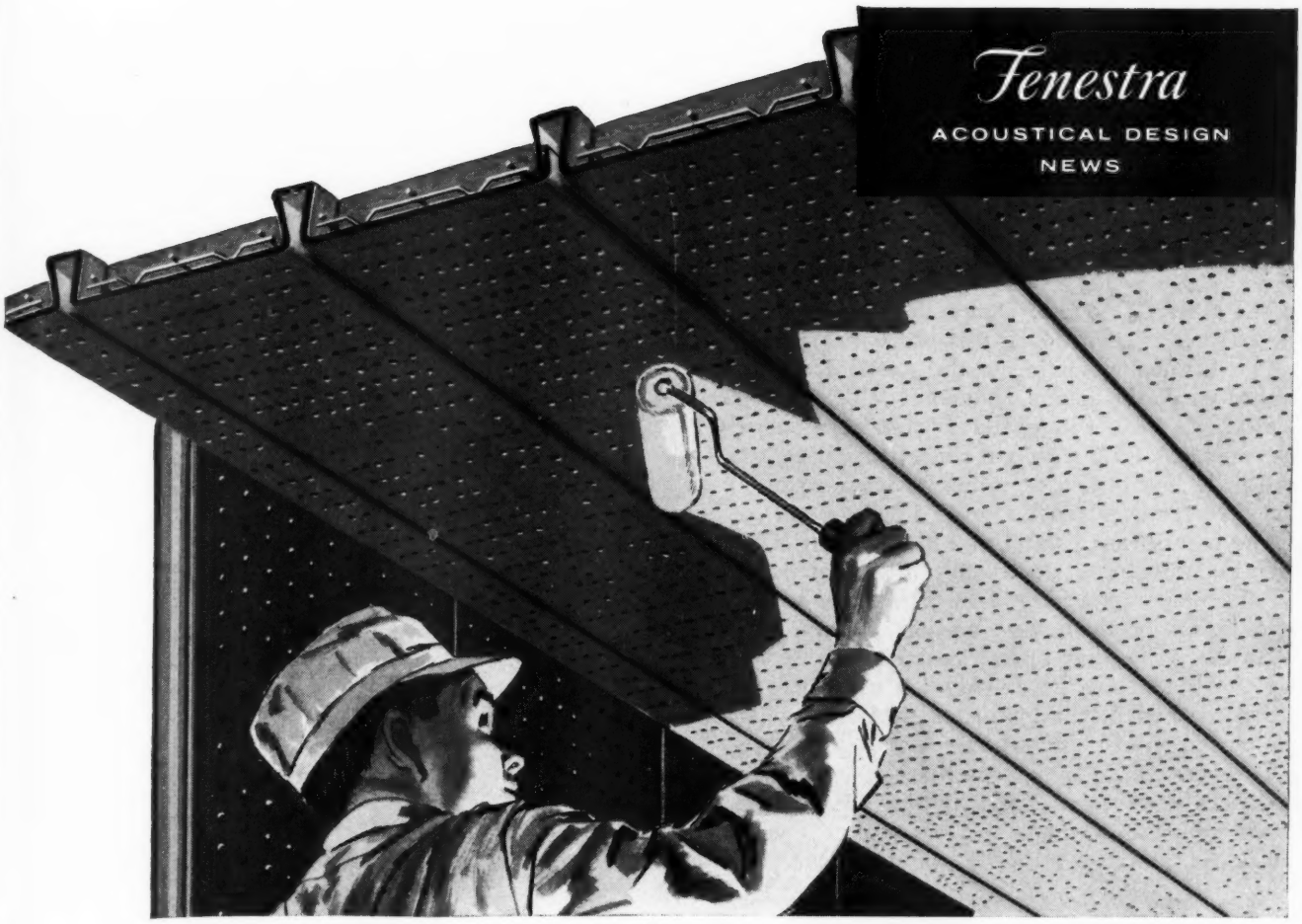


. . . for use wherever it is desirable to supply power from one duplex unit for electrical equipment requiring different voltages.

Here is the "plug-in" source of power for any 125 volt electrical device or 250 volt appliance, both supplied from the same unit at the same time. Sketch at left shows how this unit might be utilized to supply 125 volt current for a T.V. set and 250 volt current for an air conditioner. It's economical, too, because it eliminates the need for an extra box.

- Common ground serves both 125 and 250 volt outlets.
- Green, hexagonal grounding screw.
- Available side wired or side and back wired.
- Slots for 2-wire regular or polarized caps.

HARVEY HUBBELL, INC. DEPT. CE BRIDGEPORT 2, CONNECTICUT



Fenestra Acoustical Holorib gives you a*

LOW-COST STRUCTURAL ROOF WITH "BUILT-IN" NOISE CONTROL!

The science of proper noise control has a place fully as important as heating, lighting and ventilation in modern buildings. Production noise cuts deeply into worker efficiency. It wears on the nerves, reduces output, causes accidents and increases labor turnover. It may also be the cause of expensive disability claims.

Fenestra Acoustical Holorib gives you an ideal, low-cost solution to industrial noise control. It combines finished acoustical ceilings with a structural roof deck and adds thermal insulation. It is quickly and easily erected. Total cost, installed, may be as little as 75 cents per square foot.

Made of 18-gauge steel—thicker than usual metal pan ceilings—Acoustical Holorib resists damage and is easy to maintain. The smooth perforated surface may be washed or painted as frequently as needed without reducing acoustical efficiency. There is no "stuck-on" material that may be damaged under production conditions. Flaking or "drop-offs" are eliminated.

If you are now planning a new industrial building or warehouse, you should get complete information on Fenestra Acoustical Holorib roofs. Mail the coupon below for your FREE copy of the 1957 *Fenestra Building Panel Catalog* or call your local Fenestra representative, today.

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Your Single Source of Supply for
BUILDING PANELS • DOORS • WINDOWS

Fenestra Incorporated
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Please send me 1957 *Fenestra Building Panel Catalog* with complete information on Fenestra Acoustical Holorib Roof Deck.

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The project was handled by the Manu-Mine Research and Development Company, with inspections conducted by the U. S. Navy. During construction, 125 cu yds of concrete per day were used.

Kaiser Geodesic Dome Erected in 23 Hours

The Kaiser Geodesic Dome, in Hawaii, was completed in a record 23 on-the-job working hours.

The Dome, which forms the exterior for a new auditorium at Kaiser's Hawaiian Village resort in Waikiki, is 48 feet high and 152 feet in diameter. It is composed of 575 diamond-shaped cambered panels of 9 to 11 feet in length, joined to form a rigid, high strength spherical shell.

The record time established is the result of a combination of factors. The design of the dome permitted all assembly operations to be performed at ground level by raising the dome a section at a time.

No more than five minutes instruction was necessary for the men who were to learn the simple installation method. Light materials kept fatigue among the workmen at a minimum.

To connect the hyperbolic parabaloids, Huckbolt fasteners were used. The fasteners consist of a pin and a collar, both made to close dimensional tolerances. As the pin is pulled by the fastening tool, the collar is swaged into locking grooves. When tension is just right, the pin automatically breaks flush with the collar at the breakneck groove provided in the fastening design.

The exposed fasteners on the dome's outer surface required no sealing, since the driven fasteners form a leakproof joint at the aluminum panel surfaces.

SIMPLE FASTENERS SAVED MAN-HOURS.

Depend On POSEY For Large O.D. Fabricated Steel Pipe

Posey has the experience as well as the facilities for fabricating almost any type of pipe from 20" diameter and larger . . . for high pressure, high temperature service in water lines, for sewage outfall lines and similar applications. Trust Posey to meet your most rigid specifications . . . with special attention to budget and delivery requirements. Write for complete information without obligation.

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Steel Plate Division Lancaster, Penna.

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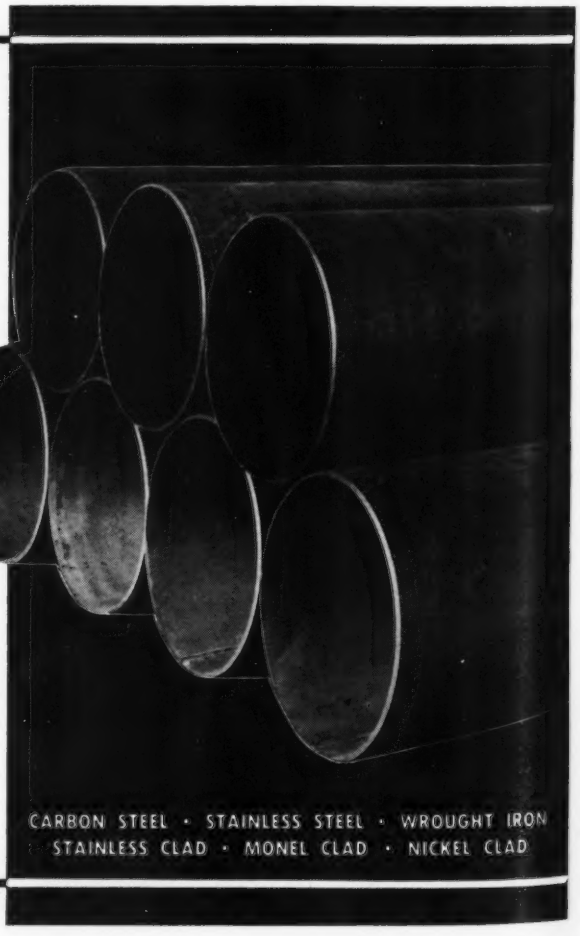
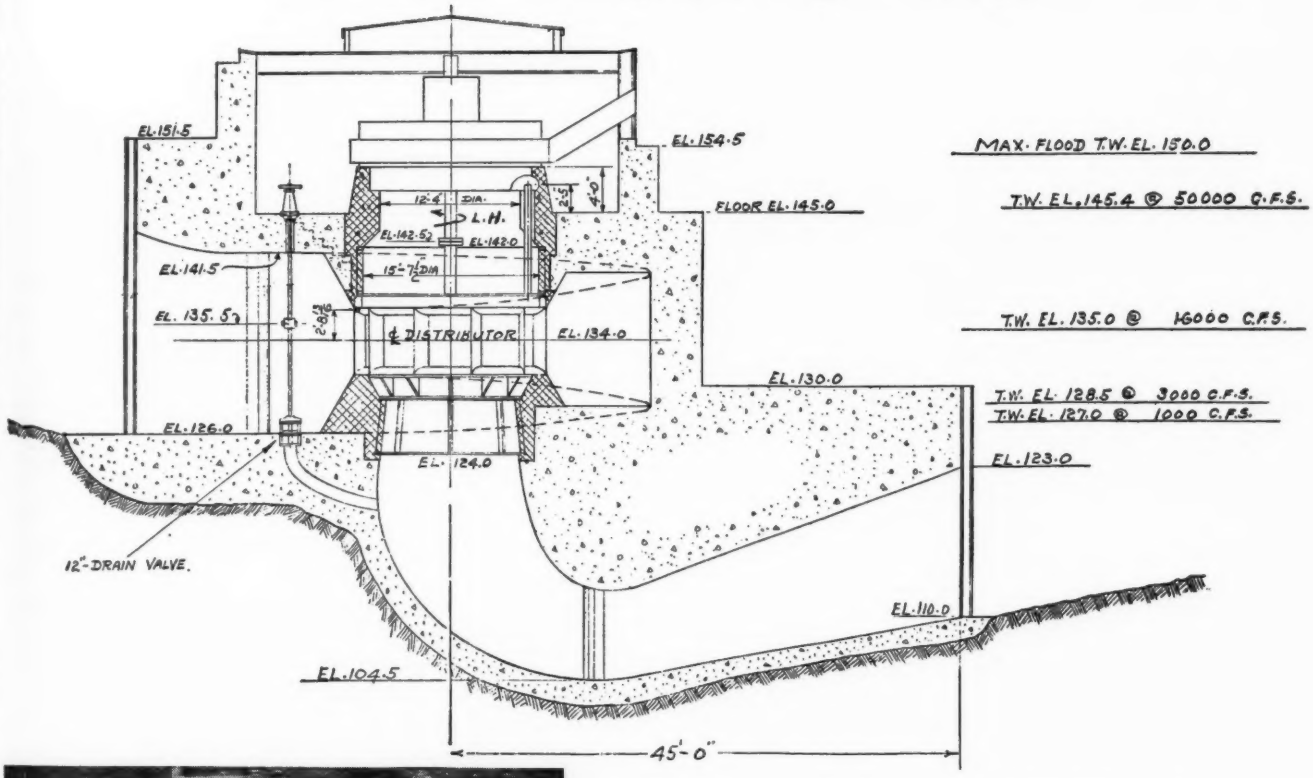
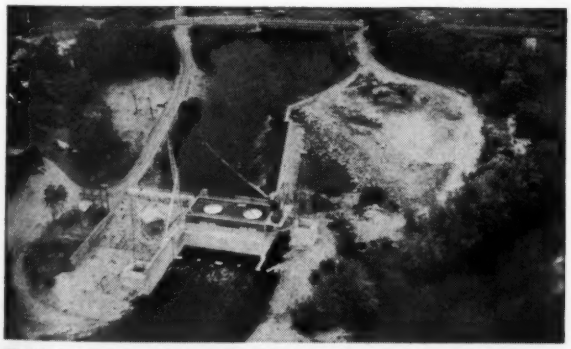


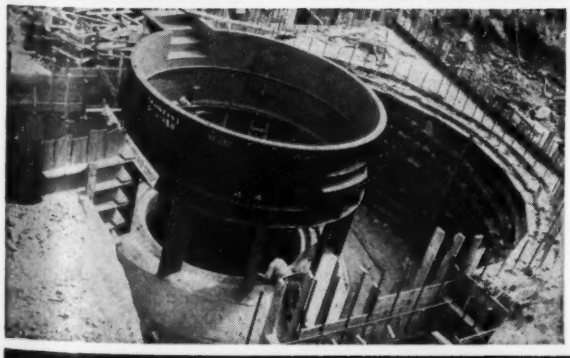
CARBON STEEL • STAINLESS STEEL • WROUGHT IRON
STAINLESS CLAD • MONEL CLAD • NICKEL CLAD

at the Central Maine Power Company's Bar Mills Station

Two Leffel Turbines Help Boost Power Output By 150%







An increase in annual output from 8,500,000 KW hours to 21,000,000 KW hours is expected by the Central Maine Power Company as a result of the recently completed rebuilding of their Bar Mills Hydroelectric Station. Two Leffel turbines—replacing four smaller turbines installed in 1919—play a major role in the Bar Mills redevelopment.

Each of the turbines is rated to develop 3,000 HP at 120 RPM under a twenty foot net effective head. The turbines, of the fixed-blade propeller type, are installed in concrete spiral casings and mounted on curved concrete elbow draft tubes.

The top view at the left shows the completed power plant and dam; the bottom view shows the installation of the turbine stay ring and pit liner in the concrete spiral casing.

Here and throughout the world, Leffel turbines are economically and efficiently harnessing water power. Before you plan any future turbine installation, get the facts on efficient, reliable Leffel turbines tailored to meet all your hydroelectric power requirements. Write today for complete information.

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FOUNDED IN 1862

THE JAMES LEFFEL & CO.

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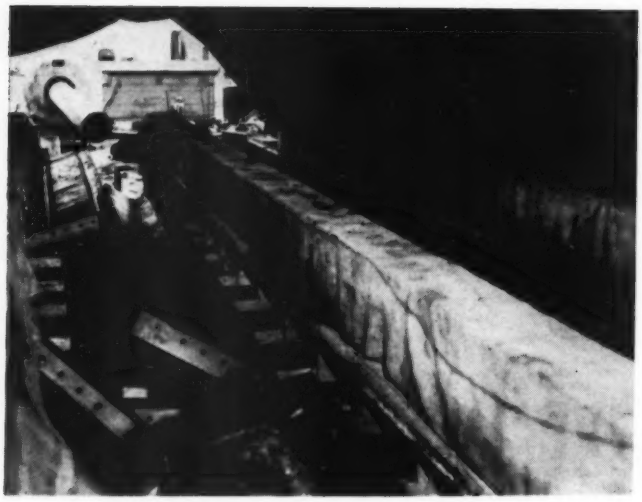
MORE EFFICIENT HYDRAULIC POWER FOR 95 YEARS



WEATHER DIDN'T STOP IBM PROJECT.

Use of Canvas Tarpaulins Allows Winter Construction

The use of 350 Hoosier canvas tarpaulins enabled a contractor in Lexington, Ky., to continue erection of post-tensioned concrete girders and beams during winter weather.

Working on a plant for the Electric Typewriter Division of International Business Machines Corp., the contractor fastened the tarps to form a mammoth canvas cover over a framework of lumber.

Hot air was blown into the enclosure, so the concrete would cure uniformly. More than 20,000 cu yds of concrete were used in pouring the prestressed concrete members, making the Kentucky project one of the largest post-tensioned concrete construction projects on record. Hot air was blown over each newly-poured unit for a seven-day period.

The project was designed by Fordyce & Hamby, Architects, of New York City.

Create Fresh Water Lakes In Louisiana Game Preserve

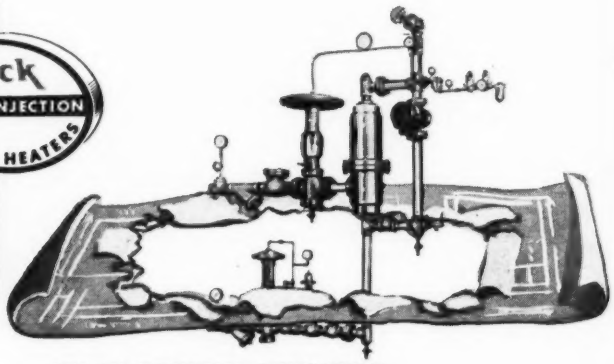
Nine fresh water lakes have been created on Louisiana's Rockefeller Wildlife Refuge and Game Preserve to prevent the intrusion of salt water into the inland marsh area.

The water engineering program, for an area near Lake Charles, included a series of shallow levee lakes; canals for distribution of fresh water; pumping plants, siphons, drainage structures, and pump discharge lines for the introduction and control of fresh water; and water control structures to keep the salt water out of the canals.

The project was based on 11 water control stations, with 30-in. pipelines allowing barge-mounted pumping plants to introduce fresh water into the shallow lakes in the area.

Specify "SAVINGS" for your clients!

Pick STEAM INJECTION WATER HEATERS



INSTANTANEOUS HOT WATER HEATER

Show your client how to save on maintenance and operating costs with a Pick Instantaneous Water Heater. No lost time waiting for water to heat; no lost heat from water standing in storage tanks; no wasted floor space. Designed for high pressure steam (40#-125# psi) the Pick Heaters are the most efficient water heaters your clients can use. Check these other outstanding features.

- Instantaneous Hot Water — no waiting, water is heated in a flash to exact temperature, in volume required.
- No Storage Space — compact design permits out-of-the-way installations in corners, on walls, overhead, etc.
- Maintenance Cost Is Low — can be cleaned in minutes, worn parts easily replaced.
- Exact Temperature Control — Pick Heaters can be operated at high or low loads with minimum temperature fluctuations. And it's done quietly.
- Installation Is Inexpensive — only ordinary pipe connections are required.

FOR ALL INDUSTRIAL APPLICATIONS

Primary Heater
A primary source of hot water up to 300 gallons per minute at 140° F. rise.

Supplementary Heater
Easy installation and accurate temperature control makes them invaluable for "spot" applications near point of use.

"Booster" Heater
To augment overloaded or inadequate facilities. Will automatically "boost" and correct temperature deficiencies.

Mail this coupon today for further information on Pick Instantaneous Water Heaters, to:

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Company..... Title.....

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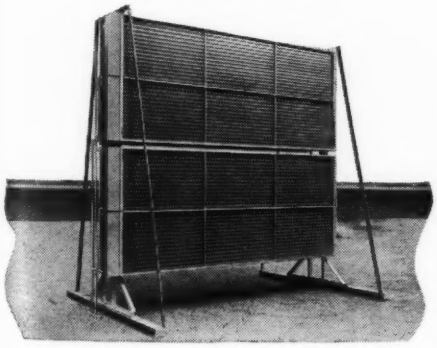
PICK MANUFACTURING CO. West Bend, Wi.

KRAMER UNICON GETS BIGGER and BIGGER

There is only one answer to large capacity condenser problems — the KRAMER UNICON. Every day more engineers plan larger tonnage installations — 50, 100 and even — 800 tons. And every day UNICONS are shipped to all parts of the world for giant-sized installations. No other air-cooled condenser can match the long, successful record of UNICON, backed by thousands of applications since 1937 — in the widest range of tonnages and climatic conditions. Your condensing problems can be best answered by use of the best — the KRAMER UNICON.



Space-saver UNICON, *as illustrated,* serves a 60-Ton air conditioning system, yet takes but 70 sq. ft. of roof space.

UNICON is a remote-type air-cooled condenser that requires no water. KRAMER UNICON can be used with any size compressor, REGARDLESS of horsepower. Any size refrigeration or air conditioning system can be air-cooled with UNICON, REGARDLESS of tonnage. UNICON requires less horsepower, less piping, is easier to install and costs less. KRAMER UNICON performs best — even in semi-tropical climates.

WRITE FOR BULLETIN U-210D

KRAMER TRENTON CO. • Trenton 5, N.J.

The pipe, produced by A. M. Byers Company of Pittsburgh, was made of iron and iron silicate, a composition which has proven resistance to corrosive salt water.

Typical of pipe installations at the Rockefeller Preserve is the inverted siphon at the navigable Bertrand Canal. Two 205-foot lines of 30-in. diameter wrought iron pipe were placed under and to the side of the headquarters canal to provide a fresh water supply for two of the lakes.

Prior to the creation of the lakes, salt water in the marsh area was destroying much of the food growth necessary for bird and animal life.

Illinois Consultants Hold First Annual Meeting

At its first Annual Meeting, held in Urbana, Ill., the Illinois Association of Consulting Engineers voted unanimously to join the Consulting Engineers Council. Application for membership will be made at the Council's Annual Meeting, in Minneapolis, Minn., on May 3.

The Illinois Association also elected new officers. Leonard K. Crawford, first president of the Association, was succeeded by Charles N. Debes, of Rockford. Junius R. Gardner, of Decatur, was elected vice president; George E. DeJong, Rockford, secretary; and Robert L. Farmer, Rock Island, treasurer. Silas Cartland, of Park Ridge, and Ray V. Tilly, of Springfield, were elected to the Board of Directors.

The Association has employed Malden Jones, of Springfield, as executive secretary.

During its first year of operation the Association worked with the Illinois Society of Professional Engineers in establishing and publishing a fee schedule for consulting engineers. This schedule has been widely distributed among Illinois engineers in private practice and is now being offered to manufacturers through the Illinois Manufacturers Association and its members.

Currently, the Association is publishing a directory of members that will give firm history engineering background, and experience of members. The publication will be distributed to industry, architects, and other prospective clients to aid them in selecting engineers for their projects.

At the Annual Meeting the members voted, again unanimously, to increase their dues from $75 per year to $100 per year. This change requires a written ballot, but the poll at the meeting indicated that the official vote is merely a formality. It is felt that this increase in dues will permit the Association to in-

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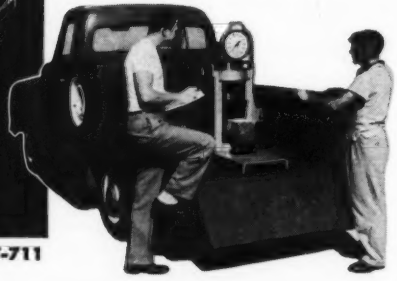
Accurate Testing to insure COMPLETE QUALITY CONTROL of any concrete product is quick, easy and economical with the NEW

CT-711 CONCRETE TESTER

This flexible, self-contained unit is ideal for PLANT or JOB-SITE use. Easily installed attachments provide for rapid conversion from CYLINDER to BLOCK, BEAM or CUBE TESTING. An electrical pump attachment is available for power operation. The CT-711 is calibrated for accuracy to within 1% of the indicated load.

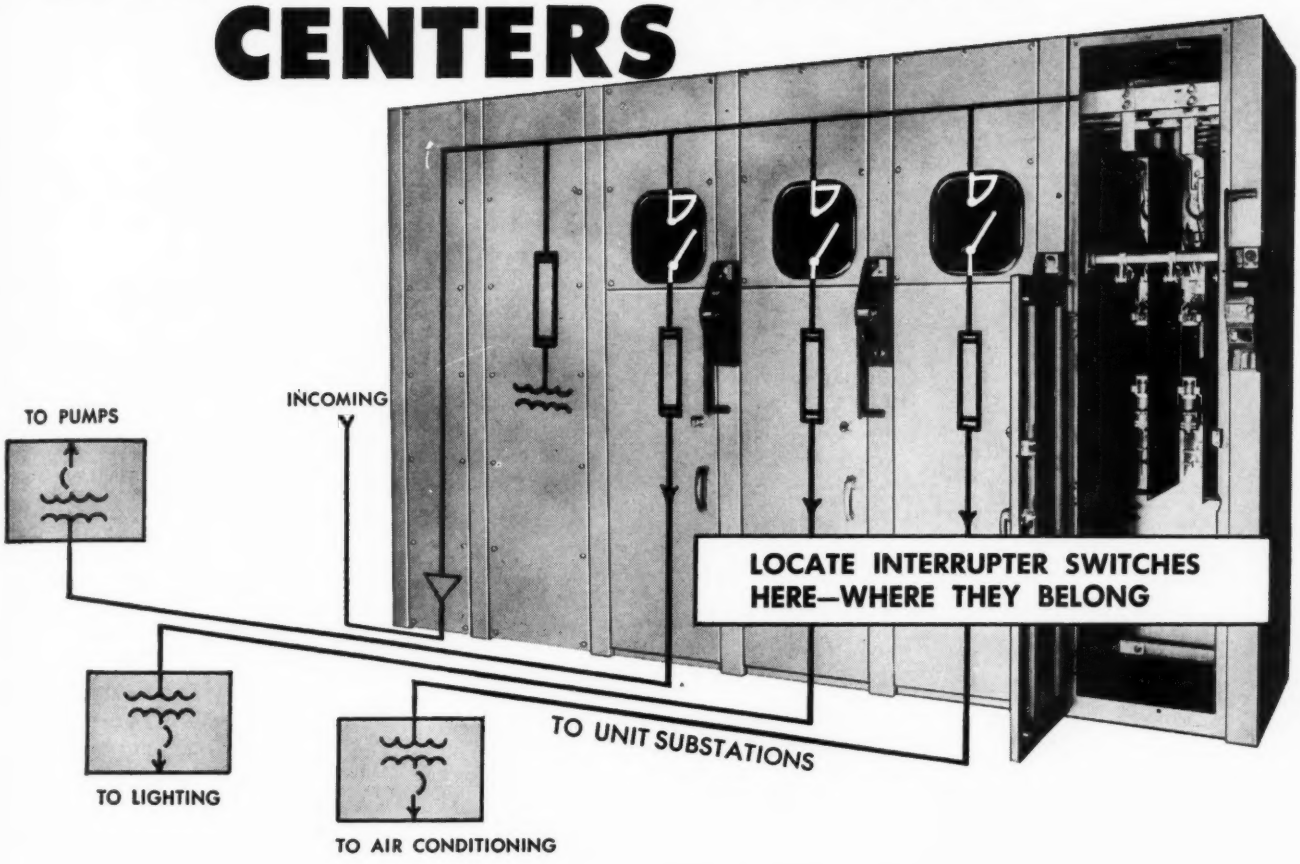
Gauges available in Metric System. Capacities to 200,000 pounds.



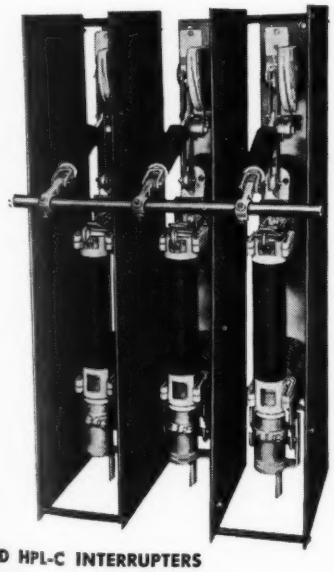
MODEL CT-711

SOILTEST Incorporated 4711 WEST NORTH AVENUE • CHICAGO 39, ILLINOIS

R&IE POWER SWITCHING CENTERS



✔ Cost Less ✔ Save Space ✔ Easier to Maintain



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Ratings—up to 14.4 Kv (110 BIL)
600 Amp. (40,000 Mom.), 1200 Amp. (60,000 Mom.)

Specify TOG-L SNAP operating mechanism for closing- in fault protection.

PSC HIGH VOLTAGE CUBICLES, standard design, indoor or outdoor, offer both efficiency and economy.

SAVE FIRST COST—Standardized, low-cost PSC cubicles with HPL-C fused interrupters, feature sectional main bus—providing compact flexibility. PSC means lower cost per feeder than scattered locations of switches in unit substations.

SAVE SPACE—With dry type load center transformers, PSC can save many square feet of floor space at the unit substation location. They also may be mounted overhead, saving additional floor space.

EASIER TO MAINTAIN—Easily operated, accessible for inspection. Can be handled with any maintenance crew.

PROTECT SYSTEM—Against faults in cables as well as transformers.

ADD FEEDERS any time—up to 1200 Amp. total load.

Ask your I-T-E Representative to show you the many PSC economies. Data available.

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R&IE EQUIPMENT DIVISION
I-T-E CIRCUIT BREAKER CO.
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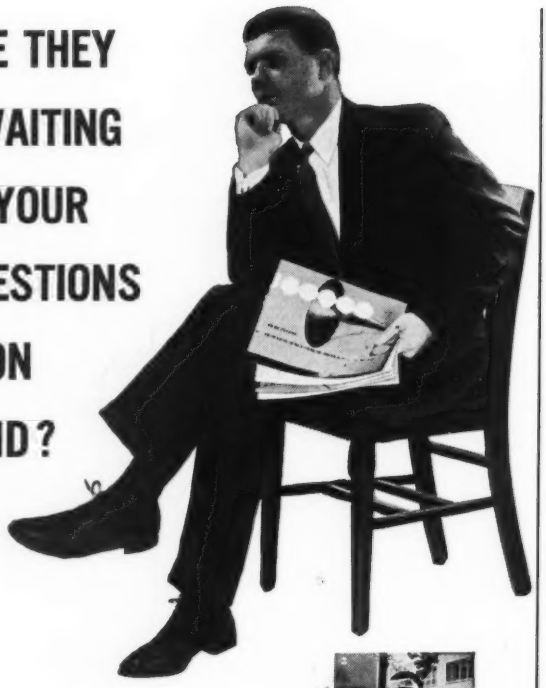
ARE THEY WAITING FOR YOUR SUGGESTIONS ON SOUND?



. . . then get help you can count on from RCA!

Your project may be anything from a grade school addition to a sports arena. Get RCA on the job with you . . . from your first rough draft of sound system specs to final system test and client okay. Your office files should include the RCA Sound brochures shown at right. The coupon brings yours. Your RCA Sound Distributor also has many valuable suggestions about the latest audio techniques. He can supply detailed application information on RCA equipment to handle nearly every requirement: sound amplifying and reenforcing systems; internal automatic telephone switchboards; electronic intercoms; "Antenaplex" master antenna systems. RCA Sound Distributors are listed under "Public Address and Sound Systems" in the classified directory.

Send for brochures . . . see our catalog 32a/ra in Sweet's Architectural File.

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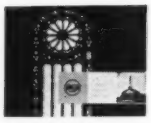

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Company.....
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City..... Zone..... State.....

crease its work in behalf of the consulting engineers in the state of Illinois.

Public No Longer Notices Slight Drop in Voltage

The public has become accustomed to minor light variations, so it no longer is necessary to maintain such a close watch over voltage regulation.

Speaking at the Great Lakes District Meeting of the American Institute of Electrical Engineers, R. W. Meisner, of Commonwealth Edison Company, Chicago, explained that 20 years ago when electric appliances were comparatively rare, voltage was kept as constant as possible to prevent light flicker. Now, with many appliances in use, the public makes few complaints about a slight voltage drop.

An investigation showed that while air conditioning units cause some voltage drop, "it is recommended that no additional service facilities be provided unless in connection with a complaint, [then] special consideration should be given to correct the condition where economically feasible and possible," Meisner said.

However, when the voltage varies more than 8 to 10 volts, Meisner recommended the installation of a separate circuit.

The electric company investigation showed that air-conditioning units do not cause cyclic flicker.

Colorado Delays Tunnel For Continental Divide

Colorado has delayed construction of a proposed tunnel to go beneath the Continental Divide.

As originally introduced in the state legislature, the bill "authorized and directed" the State Highway Commission to bore a highway tunnel through the divide, regardless of whether it would be part of a Denver-Salt Lake City federal interstate highway.

Gov. S. L. R. McNichols has signed an amended version of the bill which authorizes the highway commission to issue up to $18 million in revenue bonds to finance the tunnels as soon as a highway designation is made or after Jan. 1, 1958, if no designation is received.

Employers Notice Degrees More Than Natural Aptitude

Too much emphasis is placed on an engineering degree these days, the Institute of Radio Engineers was told at a recent annual convention.

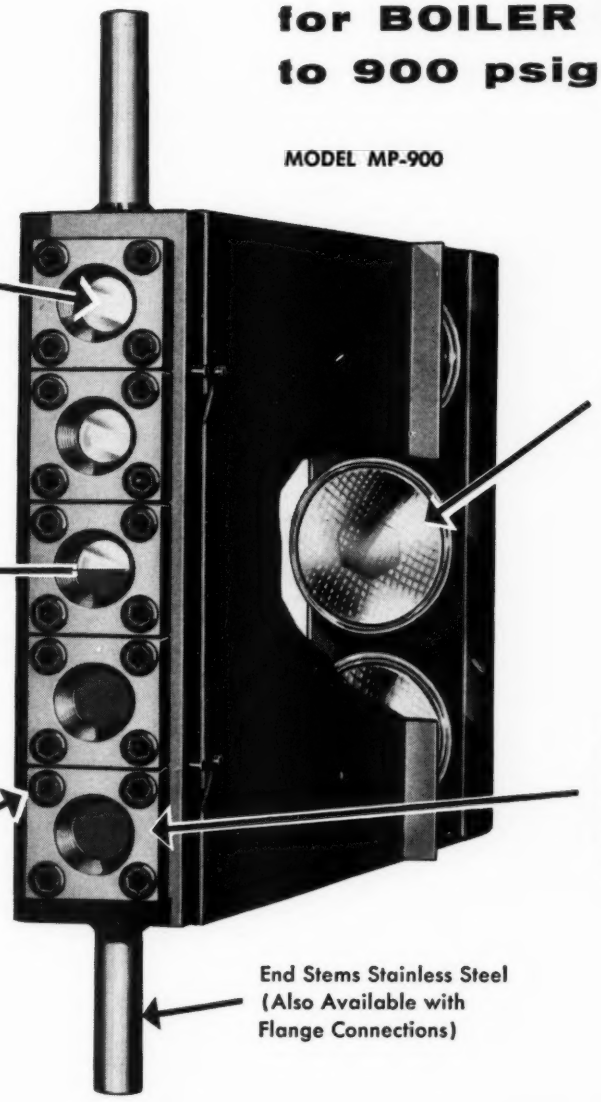
Carl G. Sontheimer, executive vice president of CGS Laboratories Inc., Stamford, Conn., said: "If Thomas A. Edison and the Wright brothers were 20 years old today, they would have great difficulty in finding technical positions worthy of their talents.

"We seem to have forgotten that many of the basic technical inventions — the electric light, the phono-

Sure-Reading ...DIAMOND "Multi-Port" Bi-Color Gauge

for BOILER PRESSURES to 900 psig

MODEL MP-900


Ports Have Individual Round Glass, Mica and Gasket Instead of Long Strips
"Sealed Beam" Lamps in "Hi-Lite" Illuminator
STEAM SHOWS RED
WATER SHOWS GREEN
Gauge Not Removed from Boiler for Gasket Changes and Other Normal Maintenance
Complete Port Change and Cut Back into Service in Minutes Instead of Hours
End Stems Stainless Steel (Also Available with Flange Connections)

Also available is Model MP-3000 for boiler pressures to 3000 psig

The individual round ports each having its own round glass, round mica and round gasket (instead of the conventional long strips) means less stress and strain . . . resulting in greatly reduced maintenance. When replacement is required, it is usually only one port . . . which can be changed in a very few minutes . . . and without removing the gauge from the boiler.

The Diamond Bi-Color feature is another important advantage of the MP-900 Multi-Port . . . steam always shows red and water always shows green. There can be no question of the water level.

Recommended for both new and old boilers up to 900 psig, the MP-900 Multi-Port will give you a new standard of gauge operation. Use the coupon below for additional information.

7757

DIAMOND POWER SPECIALTY CORP. CE
LANCASTER, OHIO

Please send me without obligation a copy of new Bulletin No. 2044 explaining the advantages of the Diamond MP-900 "MULTI-PORT" Bi-Color Gauge for all boiler operating pressures up to 900 psig.

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Diamond Specialty Limited • Windsor, Ontario

How to get smooth concrete surfaces at less cost

By simply coating plywood forms with A. C. Horn's Formfilm your contractor can get a finish that eliminates 85% of normal concrete rubbing and cleansing, because Formfilm eliminates grain marks and oil stains. Thus a saving of 10¢ per square foot is possible. (This is based on 50,000 square ft. area of poured concrete.)

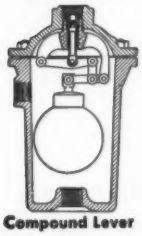
You also can save as much as 25% in painting costs on material and labor, because the denser surface accepts paint better. For details on Formfilm see Sweets' Catalog, Construction Materials Section, page 17, or write Dept. H52-5100.

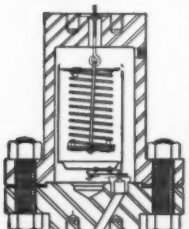
A. C. Horn Companies
SUBSIDIARIES AND DIVISIONS
Sun Chemical Corporation
10th Street & 44th Avenue, Long Island City 1, N. Y.

Float Traps for Discharging Liquid from Gas

Any Pressure up to 3500 psig!

Direct Acting


Compound Lever


Open Float Trap

Armstrong Float Traps Give You:

Long Life—Stainless steel working parts . . . stainless or chrome steel valve parts . . . semi-steel or forged steel bodies and caps.

Low Cost — Many parts used in these traps are mass produced for Armstrong Steam Traps.

Complete Range of Sizes—½" through 2" pipe connections.

Unconditionally Guaranteed to satisfy you.

Literature on Request—tell us your problem. We'll supply the data without obligation to you.

Armstrong Machine Works
9652 Maple Street,
Three Rivers, Michigan

ARMSTRONG
FLOAT TRAPS

graph, and the airplane to name but a few — were made by men without an engineering degree. There now are many research problems that can be solved only by teams of men with formal scientific training, but the day of the 'attic inventor' is not past in electronic development."

Sontheimer said his firm feels that a man who has made electronics a hobby since his early teens is a "better bet" than a college-trained boy who took electronics simply because he heard it was a sure way to make a living. However, a college education would contribute to the success of the "attic-inventor," he added in closing.

Roadside Plantings Contribute To Safety, Utility, Economy

The planting of roadsides along modern expressways can contribute to the utility, safety, beauty, and economy of the roadways, according to Oliver A. Deakin, parkway and landscape expert for the New Jersey State Highway Department.

Woody shrubs or vines can be used in preference to grass for cuts or fills, saving the future mowing costs and helping the appearance greatly, Deakin said. Thorny shrubs also make an effective fence against pedestrians or animals.

A buffer of deciduous trees and shrubs, and coniferous trees and broadleaf evergreens can be used to protect urban residents from traffic noise, dust, and fumes.

"Border plantings of this type have helped overcome public resistance to the construction of new highway facilities through their neighborhoods," Deakin added.

The landscape expert said plants have been used effectively for screening headlight glare and for traffic guidance on the Merritt Parkway in Connecticut, Henry Hudson Parkway in New York, and on the Garden State and Palisades Interstate Parkways in New Jersey.

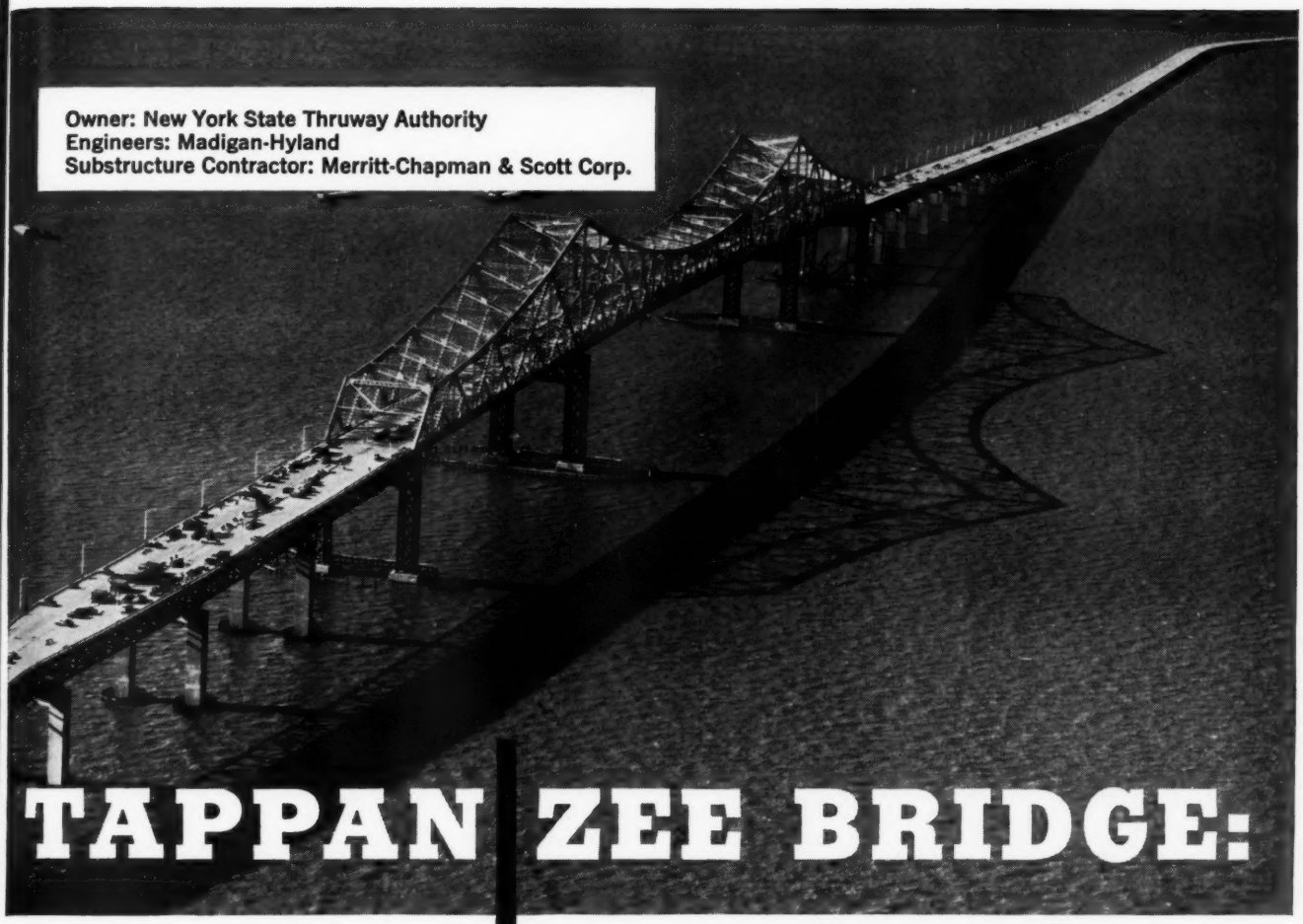
Japanese Rose, and other shrubs, are an added safety factor. Deakin said the Japanese Rose can safely stop vehicles crashing into the planting at 50 miles an hour without causing any injuries to the occupants. "Similar plantings may be used as a substitute for costly guard fence that requires yearly, costly maintenance from the time it is erected," Deakin concluded.

Boston Institute Schedules Design Problem Solving

A six-weeks program for advanced studies in design problem solving will be held this summer by Boston's Institute of Contemporary Art.

Although enrollment is limited, preference will be given to industrial designers, engineers, and design directors. Tuition is $600, with special rates for those attending two, three, or four weeks.

Among the lecturers will be R. Buckminster Fuller, designer and inventor of the Geodesic Dome,



Owner: New York State Thruway Authority
Engineers: Madigan-Hyland
Substructure Contractor: Merritt-Chapman & Scott Corp.

TAPPAN ZEE BRIDGE:

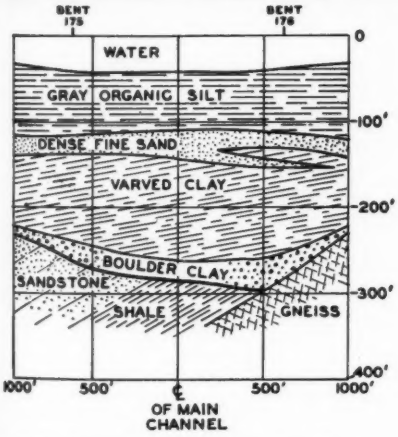
you can't see the toughest problem

Placing the foundations for the center cantilever span of the $60-million Tappan Zee Bridge was a major construction triumph! Featuring buoyant concrete caissons, this famous structure carries the New York Thruway 2.8 miles across the Hudson River from Nyack to Tarrytown.

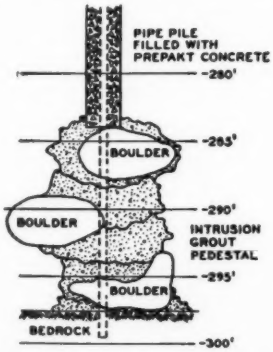
Substructure design called for 30-inch pipe piles to take part of the dead load and all of the live load, but unusual subsoil conditions (diagram) caused unprecedented problems. Boulders and weak bedrock prevented firm pile bearing; 260 to 300-foot piles made tremie concreting impractical. When these conditions were encountered, INTRUSION-PREPAKT was called in.

After airlift mucking, all 146 piles were filled with PREPAKT concrete made by consolidating preplaced aggregate with INTRUSION grout. This was followed by drilling, washing and INTRUSION grouting the area below the piles to provide necessary point-bearing for the piles. This consolidated the seamy gneiss and decomposed sandstone producing a direct, strong connection to bedrock for piles stopped by boulders.

Modern I-P techniques thus were vital to the success and economy of the unique Tappan Zee foundations. When you encounter difficult foundation problems, contact: INTRUSION PREPAKT, INC., Room 568-F, Union Commerce Bldg., Cleveland 14, Ohio. In Canada: INTRUSION-PREPAKT, LTD., 159 Bay St., Toronto, Ontario.



Subsoil profile at Tappan Zee site.



Pedestal build-up with INTRUSION grout supports piles halted above bedrock by boulders. Piles were filled with PREPAKT concrete when great length made other methods impractical.

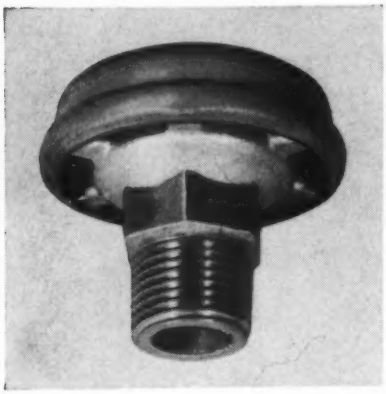
INTRUSION-PREPAKT, INC.

OFFICES IN PRINCIPAL U. S. AND FOREIGN CITIES

Intrusion and Prepakt are trade marks of Intrusion-Prepakt, Inc., whose methods and materials are covered by U. S. Patents Nos. 2313110, 2655004, 2434302 and others, also patents pending.

BREATHER-FILTER

protects housings, crankcases, storage tanks.

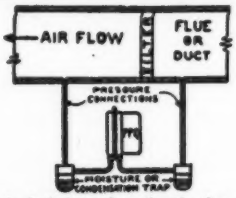


The Air-Maze breather-filter keeps dust out of engine and compressor crankcases, gear-cases, hydraulic equipment, liquid storage tanks and machinery. Types and sizes available in both oil-wetted and oil bath models to protect every vented housing.

In the oil-wetted type, dust is impinged on a series of oil-wetted wire baffles. In the oil bath type, used where the dust concentration is unusually high, the filter media is enclosed in a bowl. Outside air must first pass through the oil, then the filter media, before entering crankcase or housing. Also functions as a backfire flame arrester.

Available in sizes from ⅛" to 3½". Permanent, all-metal, easily cleanable. Write for booklet BC-453. Made by AIR-MAZE CORPORATION, Cleveland 28, Ohio.

CONTROL FROM MINUTE CHANGES IN THE RELATION-SHIP OF TWO PRESSURES



Illustrated above is a standard application whereby the Type PPQ functions to open (or close) an electrical circuit from a variation in pressure differential due to a clogging filter.

Mercoid Type PPQ Diaphragm Differential Pressure Controls operate from minute changes (.03" water) in the difference between two pressures.

Ranges to cover most applications (inches of water) 6" vacuum to 6" pressure, and 30" vacuum to 30" pressure. Available for various circuit arrangements.

Electrical Capacity—0.3Amp. at 115V., A.C. or 0.15 Amp., at 230V., D.C. Can be furnished in explosion-proof or weather-proof cases.

WRITE FOR BULLETIN CA-3P

THE MERCOID CORPORATION
4205 W. BELMONT AVENUE, CHICAGO 41, ILLINOIS
New York: 205 East 42nd St. Philadelphia: 3137 N. Broad St.

and John E. Arnold, who teaches engineering at Massachusetts Institute of Technology.

City of Baytown Guilty Of Patent Infringement

The United States District Judge for the Southern District of Texas, Houston Division, found the City of Baytown guilty of patent infringement in connection with a grit removal installation owned by the municipality.

The court upheld the patent of the Chicago Pump Co., which has licensed more than 150 installations on the aerated grit removal patent since 1950.

After the court case was settled, the Chicago Pump Co. issued a license to Baytown.

Order Highway Departments To Finance Utility Relocations

Increased concern is being expressed in Washington over bills in state legislatures requiring the state highway departments to reimburse utility owners for costs of relocation necessitated by highway improvement.

If such reimbursement is granted and should become national policy, it would add an estimated $1.5 billion to the construction costs of the Interstate System alone, according to the American Road Builders Association.

States with laws requiring the payments from highway departments are Washington, Utah, Tennessee, North Dakota, New Mexico, Montana, Idaho, Vermont, New Jersey, and New York.

Bills to provide utility reimbursement for relocation costs also were introduced this year in Arizona, Arkansas, Colorado, Delaware, Georgia, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Nebraska, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Dakota, Texas, and West Virginia.

In Kansas, Governor George Docking recently vetoed a bill which would have required the state highway commission to pay public utilities for the costs of relocating their facilities due to interstate highway projects. The governor said he vetoed the bill because the cost was prohibitive and the utilities have the facilities on highway rights-of-way on sufferance in the first place.

The costs for Wichita alone would have been about $3 million.

Bureau of Standards Conducts Tests on Porcelain-Enamel

The National Bureau of Standards recently completed 15-year weather exposure tests of porcelain-enameled steels. A large number of samples were exposed to four climatic conditions representative of different parts of the eastern United States.

Dunham-Bush acquires Brunner Mfg. Co.
The Dunham-Bush acquisition of the Brunner Manufacturing Company and its subsidiary, The Brunner Company, brings under one management the manufacture of well established lines of heat transfer equipment and accessories, as well as condensing units and compressors, to satisfy the requirements of the Air Conditioning, Refrigeration, and Heating Industry.
Close to $109,000 was spent
Two news services were initiated in 1956. The job training
program for the retarded
the home care program
added to the Center's

What this means to YOU . . .

The combining of these two well established companies signifies greater things to come for our industry. Combined research facilities and enlarged staffs of skilled development engineers provide the means for continued advancements in new and improved products.

Our prime obligation is to serve the best interests of our rapidly growing industry — to assist in every way possible the realization of its full potential. Dunham-Bush, with the acquisition of Brunner, is better equipped than ever to fulfill that obligation. You can expect improved service and delivery on all our products . . . the assistance of our expanded engineering staff in solving your application problems.

We intend to prove to you that you benefit most when you entrust your air conditioning, refrigeration and heating orders to one source — one responsibility.

Thanks to our Dunham-Bush and Brunner customers for their continued cooperation.

Cecil Boling
PRESIDENT

Dunham-Bush, Inc.

DUNHAM-BUSH

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heat-x HEAT-X, INC. BREWSTER, N.Y.

DUNHAM-BUSH DUNHAM-BUSH (CANADA), LTD. TORONTO, CANADA

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DO YOU HAVE A FRIEND

Who Is Qualified to Receive CONSULTING ENGINEER?

If you have a friend — or know someone in your own organization — qualified to receive CONSULTING ENGINEER *free* — but not now receiving it, send us his name.

QUALIFICATIONS ARE:

1. **He must be with a consulting engineering firm engaged in private practice.**
2. **He must be a *registered* engineer.**
3. **His duties must include specification or purchase, or influence upon specification or purchase, of equipment and materials.**

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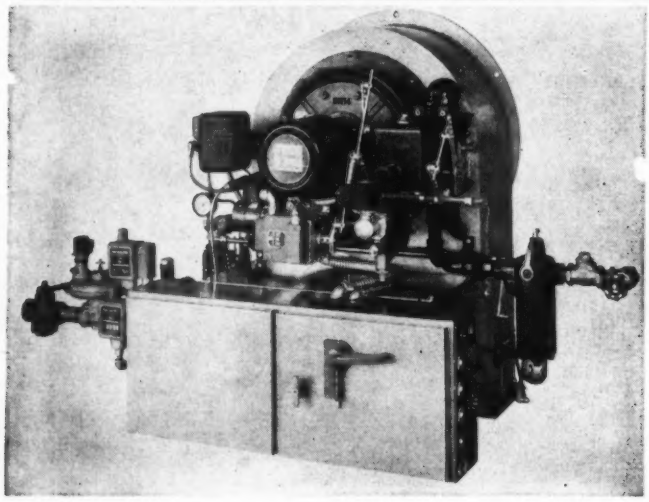
Name .....

Company .....

Title in Company .....

Company street address .....

City ..... **State** .....



JOHNSON Forced Draft BURNERS

For firing with Oil only . . . Gas only . . . or Combination Oil or Gas. Wired, tested and completely assembled at the factory ready for easy, inexpensive attachment to any boiler or heat receiver. They provide smoother, more efficient combustion regardless of stack conditions and firebox pressure variations. Powered by the famous Johnson Mod. 53 Burners, these "packaged" units are available for any heating need, in sizes from 25HP to 500HP.

Johnson Oil Burners

S. T. JOHNSON CO.

940 ARLINGTON AVE. OAKLAND 8, CALIF.

CHURCH ROAD BRIDGEPORT, PA.

Large variations were found in the weather resistance of the various enamels investigated. Affected least by the exposure were those having high resistance to acid attack.

The most resistant enamels retained more than 90 percent of their initial gloss and showed insignificant color changes. Some of the enamels with poor acid resistance (not of a type recommended for outside exposure) changed from full gloss to a dull finish.

For the study, 864 panels of 14 enamel types were prepared by 16 cooperating manufacturers. The base metal in each case was enameling iron. Exposure sites were at Washington, D.C., St. Louis, Mo., Lakeland, Fla., and Atlantic City, N. J.

Where all parts of the panels were enameled, no corrosion occurred regardless of the type enamel used. However, on many panels the reverse side was protected only with a single ground-coat application. Corrosion started at points of poor coverage and spalling of the enamel on the face opposite the points occurred after the corrosion had progressed only part way through the steel. The spalling was more prevalent under the corrosive salt air of Atlantic City than at the other locations.

Climate variations had little effect on the weathering behavior of most enamels. However, at Lakeland fairly large color changes occurred in red enamels that had been given a good rating in the acid-resistance tests.

As a result of these tests, the Bureau of Standards recommends that where general appearance, absence of fading, and ease of cleaning are important, only those enamels having class A or class AA acid resistance by the standard citric acid spot test should be specified.

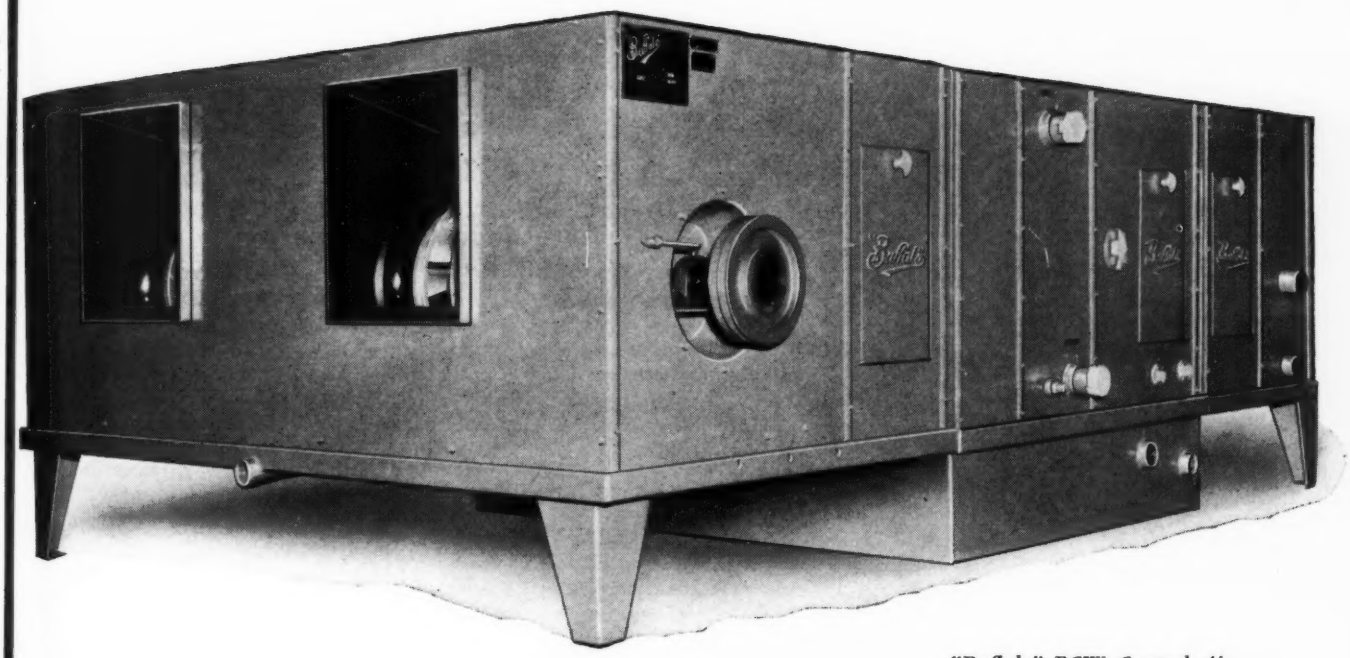
Drydock Under Design For Forrestal Class Ships

Design of an 1160-ft drydock, capable of handling the Navy's largest fighting ships, including aircraft carriers of the Forrestal Class, has been awarded to Fay, Spofford & Thorndike, Boston, Mass. Engineering will cover plans for the drydock and all auxiliary services, such as power, water, steam, and sewerage for ships whose crews remain aboard while the ship is being repaired.

To be built on the site now occupied by Drydock No. 3 at the South Boston Navy Yard, the new dock will be the largest on the eastern seaboard and one of the three largest in the country. Two others of similar size are planned, one for Bremerton, Wash., and the other for Mare Island, near San Francisco.

The Forrestal, the size ship for which the facility is designed, measures 1036 ft long, 129½ ft wide at the water line, and has a 252-ft wide deck. Full crew is an estimated 3826.

The new drydock is a part of a multi-million dollar rehabilitation and rebuilding program. Additional facilities are planned for Commonwealth Pier No. 5. The Boston Army Base also has scheduled more military and commercial shipping activity for Greater Boston and New England.



"Buffalo" PCW Central Air Conditioning Cabinet — complete facilities, including Washer section.

PERFORMANCE-PLUS for your CENTRAL-SYSTEM AIR CONDITIONING JOBS!

"Buffalo" Central Air Conditioning Cabinets are built to the same strict "Q" Factor* standards as "Buffalo" Fans — and are everywhere justifying this "extra" construction by completely satisfactory performance. "Buffalo" features include:

HEAVY-DUTY SECTIONALIZED CABINETS—rigid and strong for years of continuous service—properly insulated — interchangeable and demountable for simple installation and servicing, or later addition of sections.

QUIET, STABLE PERFORMING FANS—"Buffalo" mixed-flow fans on oversize hollow shaft, permitting as many as 4 fans in parallel supplying different systems efficiently and without pulsation. Stability over a wide operating range.

QUALITY AEROFIN COILS AND "BUFFALO" PUMPS — plus easily removable filters, outside lubrication, manual or automatic damper control — available in vertical or horizontal models. Write for Bulletin AC-120.

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

BUFFALO FORGE COMPANY
BUFFALO, N. Y.
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo"

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

Men in Engineering

A. M. Anderson, for the past five years executive secretary and chief engineer of the Niagara Frontier State Park Commission, has become associated with the firm of William H. Byrne, P.E., New York City. He will manage the city planning and highway divisions; act as liaison agent with governmental agencies; and supervise civil engineering studies and activities.

Dr. Bernard J. Gaffney has been named New York manager of The Rust Engineering Co., of Pittsburgh.

Morris, Boehmig & Tindel, Inc., consulting structural engineers of Atlanta, Ga., have elected R. L. Boehmig as president and T. A. Tindel as executive vice president and secretary. I. E. Morris continues as chairman of the board.

His 35 years of membership in the American Society of Civil Engineers were honored when Bayard Francis Snow received a certificate of life membership at the Engineers Week dinner in Miami, Fla. Snow is an associate of Rader and Associates.

Stephenson B. Barnes, structural engineer of Los Angeles, has been awarded the Los Angeles Chamber of Commerce Construction Industries Achievement award.

Barnes has served as president of the Structural Engineers of Southern California. He is a member of the California Board of Registration for Civil and Professional Engineers and is on the advisory board to the California Division of Architecture.

Ralph Birchard, former chief of the Specifications, Estimates and Reports Branch of the Air Force Academy Construction Agency, has been appointed to the staff of Rader and Associates, Engineers and Architects.

The Toledo Technical Council has named E. G. de Coriolis as "Engineer of the year for 1957." De Coriolis is research director for Surface Combustion Corporation, Toledo.

De CORIOLIS

ILIFF

James E. Iliff has been appointed vice president — general manager of Davidson-Kennedy Associates Company, engineer-contractor firm. Iliff, formerly chief process engineer of Blaw-Knox Company, chemical plants division, will be in charge of Davidson-Kennedy's Chicago office.

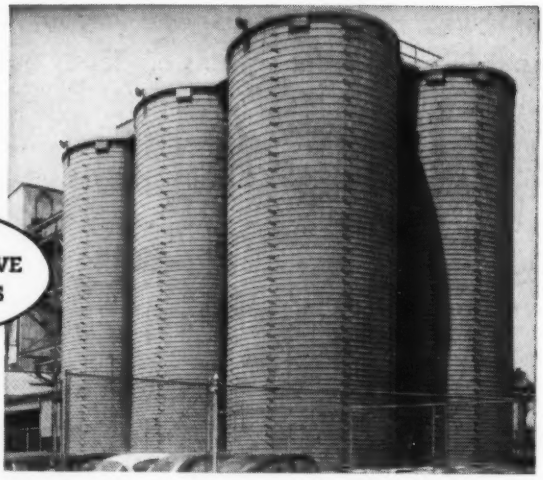
The New York offices of Fred S. Dubin Associates have been moved to 312 Seventh Ave., New York City. The firm also maintains offices in Boston, Hartford, and St. Louis.

Electrical Testing Laboratories Inc., New York, has announced the election of Gordon Thompson, chief engineer, as vice president. He has been associated with the organization since 1909, except for a brief period when he taught electrical engineering in China.

Robert N. Lankering, formerly with Ford Motor Company, has been appointed staff assistant to Hoffman S. Beagle, president of Electrical Testing Laboratories.

Holladay & Westcott, Engineers, has been incorporated in Los Angeles by William L. Holladay, Donald L. Williams, Ralph M. Westcott, and John F. Horn. The new firm will specialize in air conditioning, en-

There's a heavy conveying system atop these Neff and Fry Bins



A continuous reinforced concrete roof on the six 20' x 52½' bins carries a big screw conveyor with piers, chutes, etc. Observe that there are no additional supports from the ground. The bins themselves support the entire load.

This strikingly proves the load-bearing strength of Neff & Fry Bins. Of course, the bins also have the lateral strength to contain 4,000 tons of grain.

The walls of Neff & Fry Bins are constructed of Super-Concrete Staves. For a complete understanding, read our folder, "Bins With the Strength of Pillars." Ask for it now before you forget.

NOT EXPORTED
EXCEPT TO CANADA AND MEXICO

THE NEFF & FRY CO.

302 ELM ST. • CAMDEN, OHIO

This AMVIT* SEWER LINE is a life line carrying industrial wastes to safe disposal

Carborundum Metals Company
Washington, West Virginia

Engineers and Builders
The H. K. Ferguson Company

This is the last time you'll see that length of pipe going into the ditch. Yet it will serve a new industrial plant for many years.

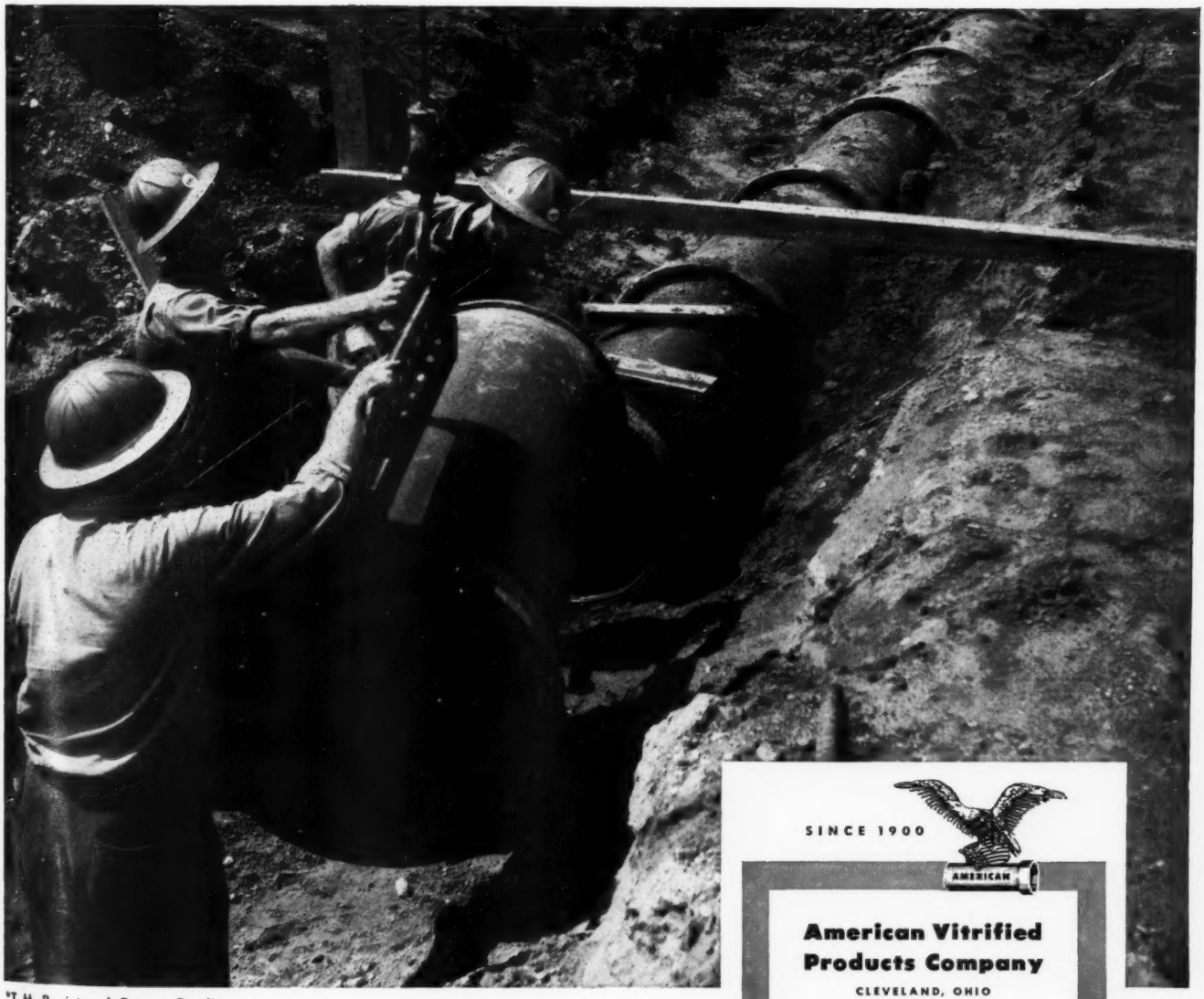
That sewer line will carry thousands of gallons of diluted acids, oils, alkali solutions and other waste material from Carborundum Metals new plant to a nearby treatment plant. Here the already diluted waste materials are made completely neutral and harmless to plant, animal and fish life. This line is one of the important life lines of that factory.

The Amvit joint was specified for this job because like the clay pipe it is unharmed by underground service.

A true mechanical joint, Amvit is made from plasticized resins of polyvinyl chloride. Thousands of feet of Amvit Jointed Clay Pipe have been installed on industrial waste disposal lines such as this.

Amvit Jointed Clay Pipe, in sizes 4" through 24", together with all fittings is available for immediate delivery in Northeast and Central States.

For more information, write or call American Vitrified Products Company, National City Bank Building, Cleveland, Ohio, or our office nearest you.



*T.M. Registered. Patents Pending.

The Amvit Joint is made of a plastic material with rubber-like characteristics. Like the pipe, the joint will withstand the most severe underground conditions. Amvit Joint is furnished on all fittings.

SINCE 1900

AMERICAN

American Vitrified Products Company

CLEVELAND, OHIO

MANUFACTURERS of: Clay pipe, flue liners, clay liner plates and concrete pipe.

Plants Across the Nation... Brazil, Indiana • Chicago, Illinois • Cleveland, Ohio • Crawfordsville, Indiana • Detroit, Michigan • East Liverpool, Ohio Fenton, Michigan • Grand Ledge, Michigan • Lisbon, Ohio • Los Angeles, California • Milwaukee, Wisconsin • South Bend, Indiana • Uhrichsville, Ohio

vironmental test equipment, heating, ventilating, process piping, refrigeration, heat transfer, and water quality control.

J. L. Medlar, Consulting Engineer, has moved to new offices at 531 Elm St., Reading, Pa.

A perpetual endowment scholarship valued at $20,000, has been established at Stanford University by D. Lee Narver, board chairman of Holmes & Narver, Inc., Los Angeles engineers and constructors.

To be known as the "Lee and Vida Narver Civil Engineering Scholarship," it will provide full tuition for one student or partial tuition for two, at the discretion of the University. The scholarship can be used for as much as six years study.

B. D. Frederico has been named project manager for Designers for Industry, Inc., Cleveland.

New address of Charles Henry Sack Associates, consulting and design engineer, is 104 Broad St., Charleston, W. Va.

The 1956 Lamme Gold Metal of the American Institute of Electrical Engineers has been awarded to Dr. Harold H. Beverage, vice president of the Radio Corporation of America and director of the RCA Laboratories. Presentation will be at the summer meeting of AIEE in Montreal, Canada, June 24.

S. S. Steinberg has resigned as dean of the engineering college at the University of Maryland to become president of the Technological Institute of Aeronautics, at Sao Jose dos Campos, Sao Paulo, Brazil. The new government-sponsored university was founded to aid development of Brazilian aviation. Dean Steinberg has been at Maryland University for 38 years.

Seelye Stevenson Value & Knecht, Consulting Engineers, have announced the appointment of nine associates. All have been with the firm for a number of years.

The new associates are Williams D. Bailey, civil engineering division; Frohman P. Davis, Ira M. Hooper, Frederick J. Kircher, Philip P. Page, and Wayman C. Wing, structural engineering division; William T. Cleland, Jack N. Keck, and Alexander Michelson, Jr., mechanical and electrical engineering division.

Dr. L. J. Buttolph has been appointed executive secretary of the National Noise Abatement Council. Dr. Buttolph, of Cliffside Park, N.J., recently retired from the General Electric Company after 38 years of work in the field of illumination.

Ralph E. Van Kleeck has joined Day & Zimmermann, Inc., of Philadelphia, as a staff consulting engineer in connection with the management and operations of utilities and industrials. He formerly was a partner in the firm of B. D. Van Kleeck, Inc., a dental, medical, and hospital equipment company of Poughkeepsie, N.Y.

New president and technical director of the Metals Research and Development Corporation, of Exeter, Pa., is Samuel Storchheim. Before accepting his new position, Storchheim was chief of nuclear manufacturing engineering and research for the Glenn L. Martin Company, of Baltimore, Md.

Thirteen persons have joined the staff of General Nuclear Engineering Corporation, of Dunedin, Fla.

They are Gilbert M. Brown, Ann Forbes, Richard D. Gentry, R. P. Hancock, Raymond J. Impara, Robert W. Long, John G. Marson, E. F. Stone, Stanley E. Turner, Michael F. Valerino, Arthur E. Walters, Janet Lee Watkins, and John M. West.

Bernal H. Swab, PE, has joined the firm of O'Brien & Gere, Consulting Engineers and Land Surveyors, of Syracuse, N.Y.

Swab formerly was consulting engineer for Gulf Securities, Inc., and International Associated Engineers, Inc., in New Orleans.

The Council of the American Society of Heating and Air-Conditioning Engineers has approved appointments to council, general, and special committees.

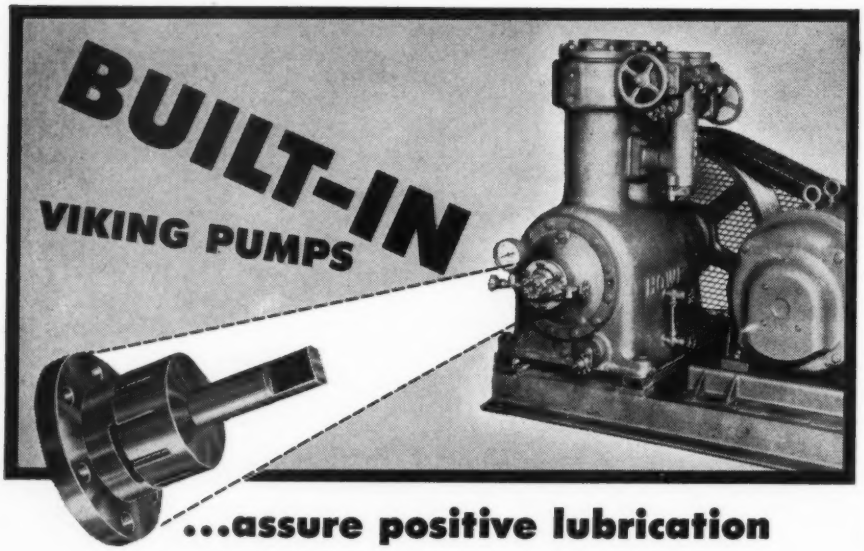
Named to the executive committee were E. R. Queer, 1st vice president, University Park, Pa., chairman; A. J. Hess, 2nd vice president, Los Angeles; and C. H. Pesterfield, treasurer, East Lansing, Mich.

Chairmen of other council committees are W. A. Grant, Syracuse, N.Y., finance; J. H. Ross, Toronto, membership; John Everetts, Jr., Philadelphia, program and papers; and A. J. Hess, Los Angeles, regions central committee.

Engineers Joint Council representative is P. B. Gordon, of New York, with Queer as alternate.

Jack B. Matson now is associated with Gerald H. Bense, Architect and Associates, Whittier, Calif.

William R. Sandberg has been appointed director of personnel for TAB Engineers, Inc., of Chicago. He formerly was vice president in charge of sales and operations for Harlee Manufacturing Company.



...assure positive lubrication

HOWE Ice Machine Company of Chicago, Illinois, uses built-in Viking Pumps to assure positive lubrication of compressor bearings, pistons and cylinder walls. Their system incorporates a Viking 3½ gpm rotor, head and idler into an integral casing. They are rugged pumps, serving dependably 10 to 20 years.

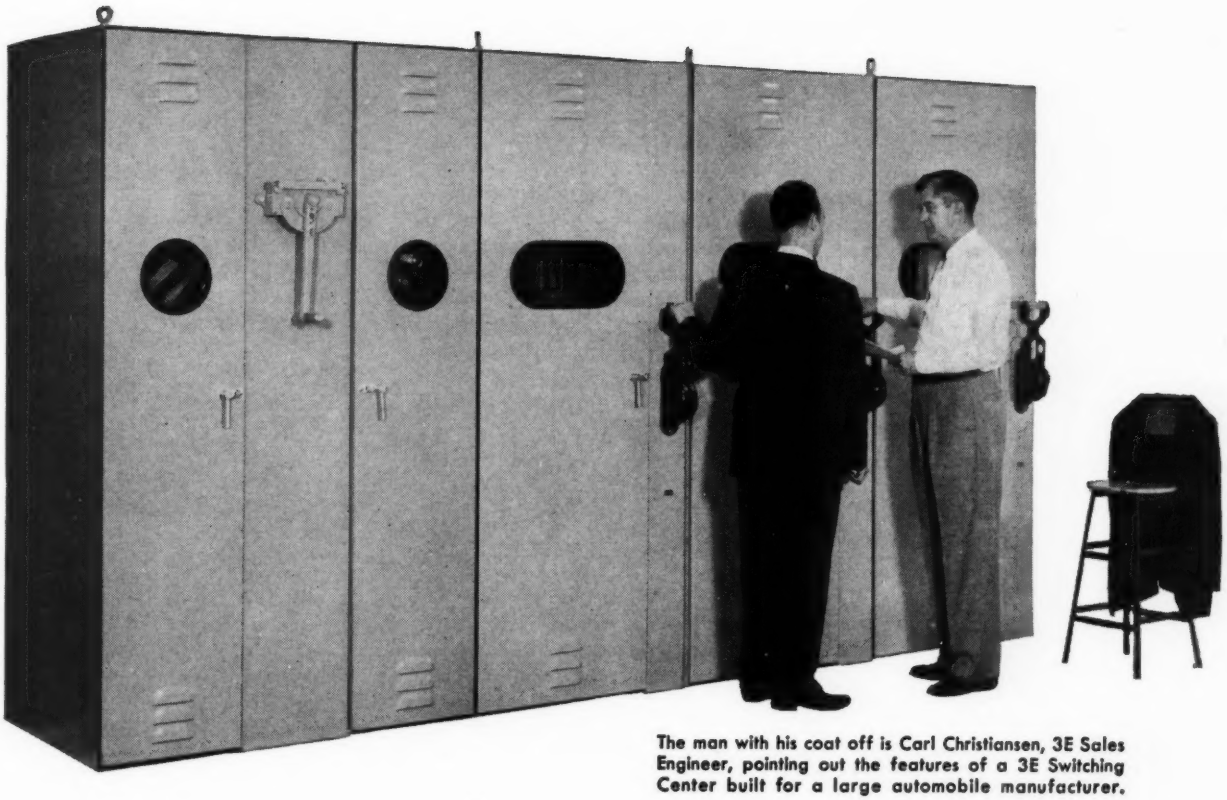
Used by Howe since 1921, Vikings have proved so satisfactory that other manufacturers have since used similar pumping systems. If you are using or planning equipment that could use built-in pumping, investigate Vikings.

To start, write for bulletin 57Sp.

VIKING PUMP COMPANY

Cedar Falls, Iowa, U.S.A. In Canada, it's "ROTO-KING" pumps

See Our Catalog in Sweet's Industrial Construction and Plant Engineer's File

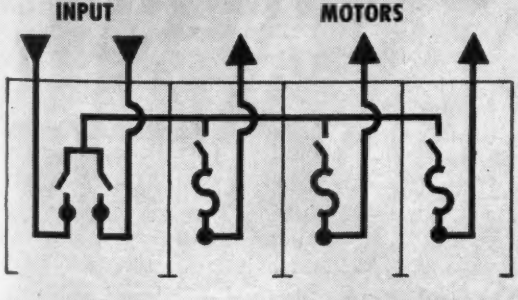


The man with his coat off is Carl Christiansen, 3E Sales Engineer, pointing out the features of a 3E Switching Center built for a large automobile manufacturer.

3E builds to meet the specs . . .
. . . *no need to compromise*

3E engineering and standard components solve a wide range of unique requirements.
There is often a temptation to sacrifice a measure of efficient design in favor of easily available standard units. At 3E we believe that equipment engineered to fit job requirements without compromise is not only economical —it is the best way to protect *your responsibility for safe precise control of power.*

The switching center shown above was built for a major auto manufacturer. It is typical of the many cases where there is *no standard package* that can do the job. The unit handles a 4800 volt input distributed to two 300 H.P. motors and one 200 H.P. motor used to drive high frequency generators. The use of 3E's **Auto Speed Load Interrupter Switches** and 3E design produced a compact, rugged switching center at a practical cost.



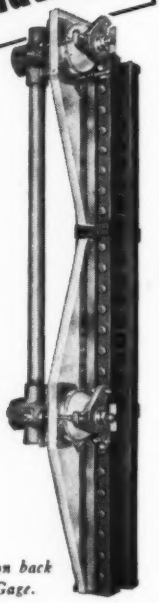
This diagram shows simple arrangement used in the switching center shown above

3E

ELECTRICAL ENGINEERS EQUIPMENT CO. Melrose Park, Illinois
Representatives in principal cities — in Canada by Powerlite Devices, Ltd.

New JERGUSON Gage Illuminator

gives up to 3 times the illumination



- lights entire gage glass
- no glare or blind spots
- low cost lighting
- explosion-proof
- UL approved
- new, one-twist lamp replacing

Easily mounted on back of Transparent Gage.

The New Jerguson EPL-56 Illuminator gives three times the illumination (and 3 times the bulb life) . . . a bright, evenly diffused light over the entire length of gage glass, thus enabling you to see the liquid level clearly and easily under all conditions. Relamping is simplified: one turn of the thumb screw and you lift out cover and bezel in one piece.

Jerguson Illuminators incorporate the principle of solid wedge lighting. Illumination from a single bulb is reflected from the angular surface of the plastic wedge and is evenly diffused through the transparent gage glass.

Jerguson Illuminators are UL approved and are built in accordance with their Standard for Electric Lighting Fixtures for use in hazardous locations for Class 1, Group D Services. They are made in a variety of sizes.

Write for Data Unit on Process Gage Illuminators.

JERGUSON

Gages and Valves for the Observation of Liquids and Levels

JERGUSON GAGE & VALVE COMPANY
100 Adams Street, Burlington, Mass.
Offices in Major Cities
Jerguson Tress Gage & Valve Co., Ltd., London, Eng.
Pétrole Service, Paris, France

Raymond Mirrer, PE and attorney, has opened an office at 150 Broadway, New York. Mirrer will handle general practice in matters concerning engineering, construction, manufacturing, and patents.

Honorary Membership in the American Water Works Association is being awarded to S. Logan Kerr, Consulting Engineer, of Flourtown, Pa., at the Annual Convention of AWWA in Atlantic City, in May. The citation describes him as "one who is internationally recognized for his superior competence in the field of hydro-mechanics. Ever willing to serve in widening the general understanding of difficult hydraulic problems."

Nelson O. Burt has been appointed head of the Industrial Development Activities Department of Rader and Associates, Miami, Fla., engineer-architect firm.

Robert H. Barclay, former vice president in charge of engineering for J. G. White Engineering Corporation, now is a consulting engineer with offices at 80 Broad St., New York, N.Y.

Theodore F. Collier has been made a vice president of Westcott and Mapes, Inc., New Haven, Conn. In charge of the civil-structural division since 1950, Collier has been project engineer for the joint office of Westcott and Mapes and Seelye, Stevenson, Value & Knecht at Branford, Conn.

J. Stephen Watkins, Consulting Engineers, of Lexington, Ky., have opened an office at 533 N. Clippert St., Lansing, Mich. Robert H. Uhl is in charge of the new office.

Robert J. Wolff has been appointed division manager in charge of engineering design, estimating, and scheduling at the Oakland, Calif., offce of Kaiser Engineers Division of Henry J. Kaiser, Wolff was formerly assistant chief engineer with Giffels & Vallet, Inc., of Detroit, Mich.

Martin Aaron has been appointed assistant to the president at Sam Tour & Co., Inc., New York City.

Francis W. Montanari, a sanitary engineer associated with the Institute of Inter-American Affairs for the past eleven years, has been appointed to the staff of the Ohio River Valley Water Sanitation Commission. He recently returned from Panama where he acted as consultant in development of sanitation installations sponsored by the Point IV technical-assistance program in Latin America.

Robert K. Loekwood has been named Assistant to the Executive Secretary of the American Society of Civil Engineers. He formerly served as executive editor of the magazine *Civil Engineering*.

In his new position, Lockwood will be responsible for coordinating the Society's activities in the Department of Conditions of Practice.

W. O. Stevens & Company, of Seattle, has moved to a new office at 7838 S.E. 30th St., Mercer Island, Wash. The new location is across the Floating Bridge from Seattle.

U. S. Fire Protection Engineering Service Inc., consulting engineering firm specializing in fire prevention and fire protection, has established a San Francisco office, with Paul D. Smith as manager. He formerly was chief engineer of Johnson and Higgins, of California.

The Fire Protection Engineering firm also has added Lester A. Eggleston, Ben A. Gant, and Stanley J. LeVeque to the staff of the Kansas City office.

Two Chicago men have received Fellow Awards from the Chicago Section of the Institute of Radio Engineers.

They are Dr. Eugene Mittelman, consulting engineer, and Dr. Rinaldo De Cola, director of engineering, Admiral Corp. The awards were given for major contributions to the field of electronics.

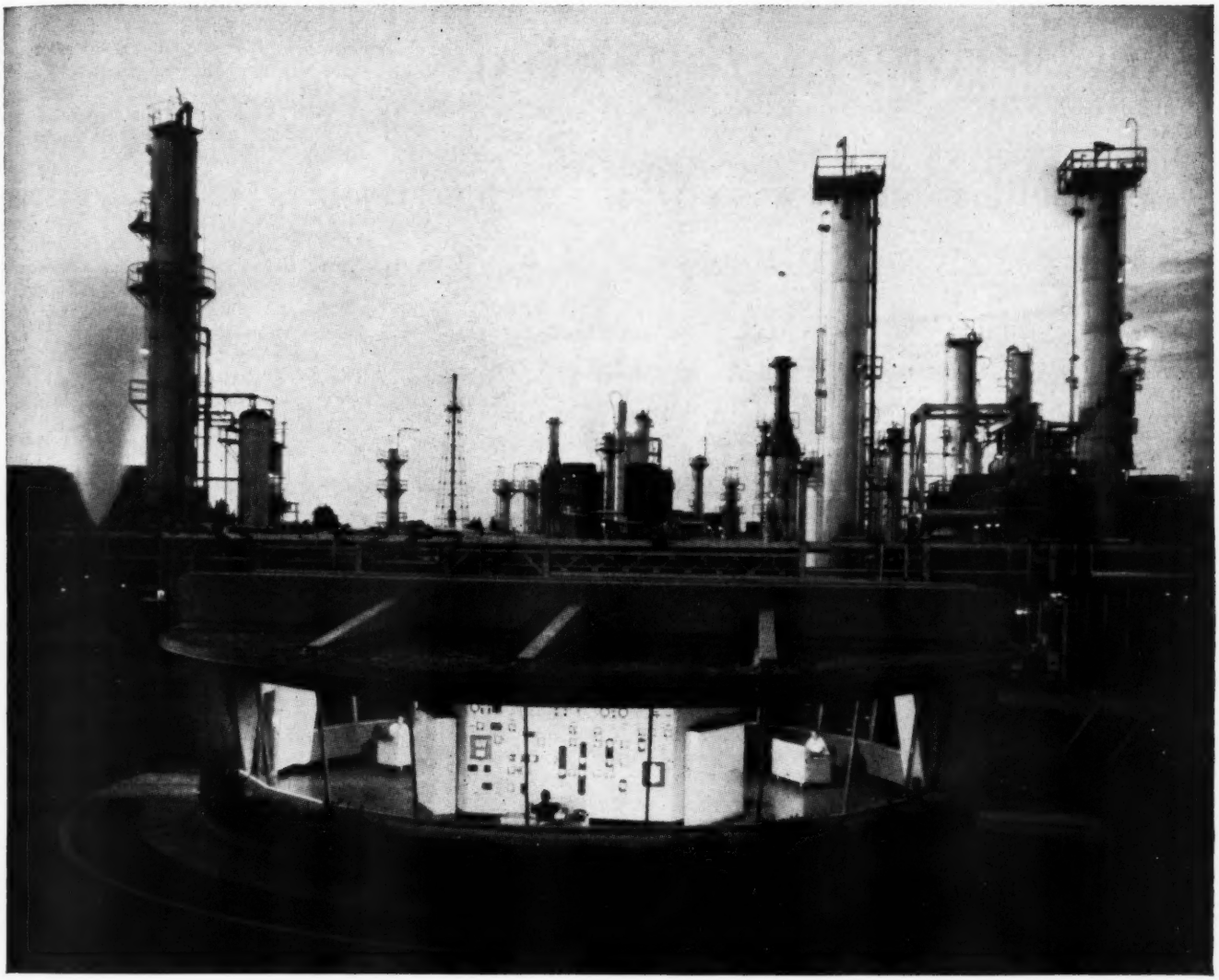
Frankland and Lienhard, Consulting Engineers, have moved to 156 Williams St., New York.

John P. Rossie has joined the firm of R. W. Beck and Associates, Utility Analysts and Engineers.

Formerly with Nance, Rossie and Associates in Omaha, Rossie will serve as principal design engineer in Beck's Columbus, Neb., office.

Earle V. Miller, associate with the firm of Johannessen and Girand and Earle V. Miller, Consulting Engineers, of Phoenix, has been appointed to the AASHO-ASCE Highway Division Joint Committee as representative of the American Society of Civil Engineers.

Two Texas consulting engineering firms — H. E. Bovay Jr., Consulting Engineers, and Reg F. Taylor, Consulting Engineer, have merged under the Bovay firm name. Partners in the new firm are H. E. Bovay Jr., Bennett W. Burns, C. A. Lawler, Richard D. Robertson, and W. M. Pauley. Headquarters are at 5009 Caroline St., Houston.



F & P AUTOMATION IN ACTION

The new alkylation unit at the McMurrey refinery in Tyler, Texas, is controlled by a graphic instrument system manufactured by Fischer & Porter Co. One man can control the entire operation of this 2200 BPD unit. In similar installations, F&P automatic digital data logging systems are successfully measuring and tabulating all operating variables.

Your clients' processes can be controlled just as efficiently. F&P's experience in supplying high-quality control systems for every kind of industry assures your clients of dependable, trouble free, high-accuracy performance. Carrying our responsibilities right on through commissioning of the control system, as well as its maintenance, relieves you of installation headaches too.

Whether you're designing a new facility or modernizing an old one, now is the time to put automation to work . . . F&P automation. For more information write to Fischer & Porter Company, 4957 County Line Road, Hatboro, Pa.

FP **FISCHER & PORTER CO.** Hatboro, Pa. U.S.A.

COMPLETE PROCESS INSTRUMENTATION

New Projects Reported

By Consulting Engineers —

ARIZONA

Johannessen & Girand and Earle V. Miller, Tucson, Ariz.
Durango Interchange. Design and plans for probable 3-level interchange structure to be located near present intersection of Durango and 23rd Ave., Phoenix, Ariz., to provide traffic interchange for three converging interstate highway routes. $1,000,000 (est.) Client, Arizona State Highway Dept.

Robert Lenon, Consulting Mining Engineer, Patagonia, Ariz.
Mineral survey for patenting of 90 lode mining claims in a single group in the Twin Buttes Mining District. Client, Duval Potash and Sulphur Co., Carlsbad, N.M., and Tucson, Ariz.

ARKANSAS

Kenneth W. Lefever Co., Little Rock, Ark.
Little Rock water supply dam. (Civil) $4,000,000. Client, Little Rock Water System.

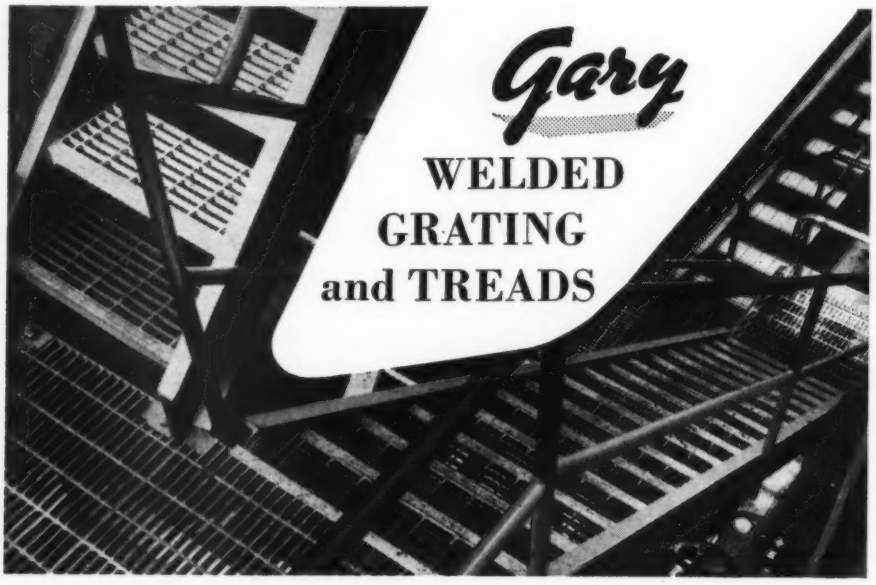
Little Rock pipe line. (Civil) $2,000,000. Client, Little Rock Water System.

Little Rock sewer. (Civil) $2,000,000. Client, Little Rock Sewer System.

Highway #10 relocation. (Civil) $800,000. Client, Little Rock Water System.

Brinkley drainage project. (Civil) $300,000.

Little Rock industrial district. (Civil) $1,000,000. Client, Little Rock Industrial Corp.



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- **TAILOR MADE**—for most economical installation.
- **RIGID STRENGTH**—sturdy resistance-welded construction.
- **LIGHT WEIGHT**—for greater load bearing capacity.
- **SELF-CLEANING**—for reduced maintenance costs.
- **OPEN CONSTRUCTION**—gives maximum ventilation and illumination.

Write For Bulletin CE-57

ROCKWELL SPRING & AXLE CO.
Standard Steel Spring Division
4015 EAST SEVENTH AVE., GARY, INDIANA

Frederic R. Harris, Inc., New Orleans, La.
Report and design for re-location of West Memphis Maintenance and Repair Base of the U.S. Engineers Department to new location. (Civil, struc., mech., elec.) $2,000,000. Client, U.S. Engineers Department.

H. E. Bovay, Jr., Consulting Engineers, Houston, Texas.
Additional power plant boilers facilities, City of Hope, Ark. Addition of outdoor 65,000 lbs-per-hr water tube boiler to operate at 400 psig, 750 F, for gas firing, with fuel oil standby. Boiler to provide additional steaming capacity for generation of electrical power with existing turbines of 2500, 1500, and 1000 kw capacity. $430,000 (est.). Client, City of Hope.

CALIFORNIA

John E. Brown, San Francisco, Calif.
Visitors' Center and employees' housing, Craters of the Moon National Park, Idaho. (Struct.) $300,000. Client, National Park Service (owner), Malone & Hooper, Arch., San Francisco.

Marin Country Day School, Corte Madera, Calif. (Struc.) $400,000. Client, Malone & Hooper, Arch., San Francisco.

Ukiah Union High School, Ukiah, Calif. (Struct.) $600,000. Client, C. A. Caulkins, Jr., Arch., Santa Rosa.

Additions to Labor Temple Carpenters Union, Santa Rosa, Calif. Prestressed concrete construction. (Struc.) $170,000. Client, C. A. Caulkins, Jr., Arch., Santa Rosa.

Stanford Shopping Center, Palo Alto, Calif. Professional buildings in exposed steel. (Struc.) $500,000. Starks, Jozens & Nacht, Arch., Sacramento, Knorr Associates, San Francisco.

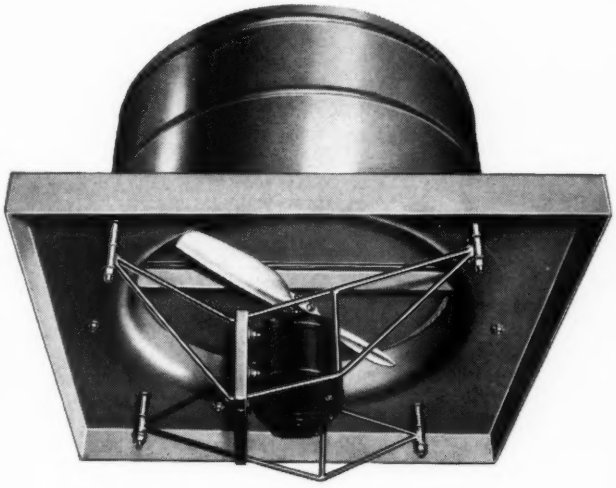
Visitors Center, Colter Bay, Grand Teton National Park, Wyo. (struc.) $200,000. Client, National Park Service (owner), Malone & Hooper, Arch., San Francisco.

The Fluor Corp., Los Angeles, Calif.
Engineer, procure, and construct 150,000 lbs-per-hr steam generator and 7500 kw electric generator. $2,000,000 (est.). Client, Pacific Lumber Co., Scotia, Calif.

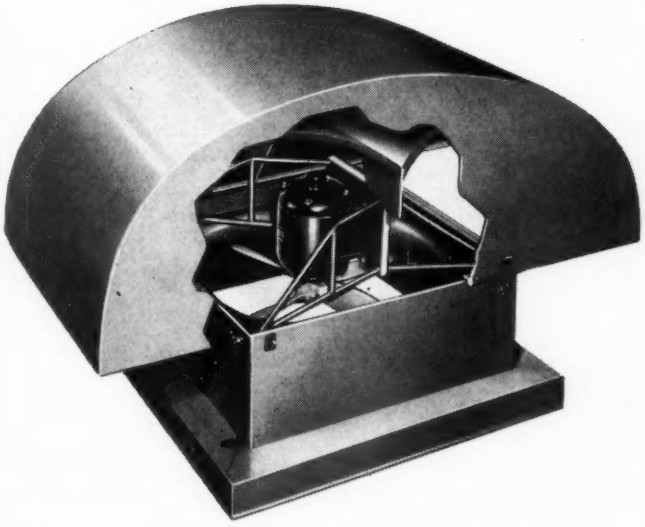
Wheeler & Gray, Los Angeles, Calif.
Juvenile hall, reinforced concrete and masonry structure. Santa Ana. $1,400,000. Client, Wildman & Faulkner, Arch.

Gymnasium, Ventura College, Ventura, Calif. Reinforced concrete frame, walls, and footings, and structural steel trusses. $700,000. Client, Harold E. Burket. Arch.

Office building for Title Insurance & Trust Co. of Los Angeles and Santa Ana, Calif. Two-story reinforced concrete. Floor and roof systems prestressed, precast joist and girder. Poured slab for composite action. Walls, precast tilt-up panels and fins. Founda-



HARTZELL VERTIJET — Windband formed from 20 gauge galvanized steel, base from 14 gauge zinc-grip coated steel. Fan ring is integral part of base sheet. Two semicircular galvanized lids at base of windband open automatically when fan goes on, close weather-tight when it goes off. Throat sizes from 18" to 60"



HARTZELL REVERSIBLE ROOF VENTILATOR—One unit does the job of two conventional one-way ventilators. This unit moves air in either direction with equal efficiency; you convert from intake to exhaust at the flick of a switch. Throat sizes from 28" to 44".

Why You Can Count on Hartzell Air-Moving Equipment for Long Life, Rugged Reliability and Minimum Maintenance

Hartzell fans and blowers are engineered and built for the exacting requirements of tough industrial service. There's no compromise with quality for the sake of shaving a few dollars on price. Hartzell fans are designed for the industrial buyer who is willing to pay for long life, dependable service and low maintenance.

Design Simplicity OF HARTZELL *roof ventilators means...*

HIGH EFFICIENCY . . .

These Hartzell roof ventilators expel large volumes of heat, smoke and fumes quickly and efficiently because simplified design reduces obstructions to air flow. There's no maze of interior braces and supports. And all Hartzell roof ventilators are tested for performance in accordance with Standard Test Codes of the American Society of Heating and Air Conditioning Engineers.

LOW INITIAL COST . . .

Elimination of complications of design and construction produce savings in production costs which are passed along to you. Hartzell design simplicity means that Hartzell roof ventilators can offer top quality construction for long life and dependable service at a price much lower than that of more complex designs.

MINIMUM MAINTENANCE . . .

By minimizing the number of moving parts Hartzell reduces the number of things that can go wrong. Lids on vertical discharge models are mounted on corrosion resistant brass rods which turn on heavy Micarta plastic bearings which require no lubrication . . . won't stick, won't rust. Fan motors are ball-bearing type, conservatively rated for continuous performance. Under normal operating conditions, the only maintenance required will be periodic motor lubrication.

Write today, or ask your nearby Hartzell field engineer for a copy of the free Bulletin A-112A. It contains all the specifications for the two roof ventilators pictured, as well as for Hartzell's Airjet, Rotary and Penthouse roof ventilators.

HARTZELL
PROPELLER FAN CO.
Div. of Castle Hills Corp.
204 Thomas Blvd. • Piqua, Ohio

ENGINEERING OFFICES IN PRINCIPAL CITIES

HOW TO GET AROUND TIME and COST FACTORS

in Protecting Pipe Against Corrosion

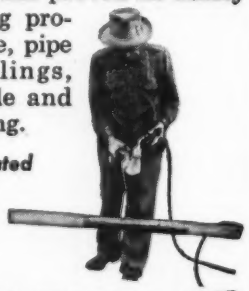
When you are faced with the problem of protecting piping underground in highly corrosive soils, a high quality coal tar coating such as called for in AWWA Specifications C-203 and C-204 is normally hot applied at a pipe coating mill. However, in many cases, the volume of pipe does not warrant this expense or the coating mill is too far away to justify the time involved.

That's WHEN Engineers Specify TAPECOAT® . . . the practical alternate hot-applied coal tar coating in handy tape form

Because TAPECOAT provides a coal tar coating equivalent in long-life protection to hot-applied coating at the mill, engineers are specifying this quality alternate material where time and cost factors preclude mill application.

This practical solution assures the protection required without the need for tar kettles, technical know-how and special crews. Field application costs are reduced because TAPECOAT is so easy to apply, using a torch to soften or bleed the pitch and then spirally wrapping it on the vulnerable surface.

TAPECOAT comes in handy rolls of 2″, 3″, 4″, 6″, 18″ and 24″ widths. Since 1941, it has proved its ability to give lasting protection to pipe, pipe joints, couplings, conduit, cable and insulated piping.



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The TAPECOAT® *Company*

Originators of Coal Tar Coating in Tape Form

1569 Lyons Street
Evanston, Illinois

tions, spread and continuous wall footings. Complete air conditioning and under-floor electrical systems. $460,000. Client, McFarland-Bonsall, Arch.

Maurice Sasso, Los Angeles, Calif.
Seven-story rigid frame, steel welded structure, Pomona, Calif. (Civil, struc.)

$3,000,000. Client, General Telephone Company of Calif.

Two-story and basement, all concrete structure, Lakewood, Calif. (Civil, struc.) $400,000. Client, General Telephone Company of Calif.

Four-story and basement, steel rigid frame and concrete construction, Ontario. (Civil, struc.) $1,200,000. Client, General Telephone Company of Calif.

Cline, Zerkle & Agee, Berkeley, Calif.
School — 10 classrooms, 2 kindergartens, multi-use administration unit, Orcutt, Calif. (Civil, struc., mech., elec.) $300,000. Client, Orcutt Union School.

Woodward-Clyde & Assoc., Oakland, Calif.
Ideal Cement Co., Redwood City, Calif., Plant No. 2. (Foundation) $10,000,000. Client, Ideal Cement Co., Denver, Colo.

Shopping center, El Cerrito, Calif. (Foundation) $10,000,000. Client, Emporium Capwell Co., San Francisco, Calif. and Albert-Lovett Co., Berkeley.

Byrl D. Phelps, San Diego, Calif.
18th street in National City, consisting of curbs, sidewalk pavement, drainage on main east and west road. (Civil) $163,471. Client, National City.

Construction of sanitary sewer system, 8 to 10-in. vitrified clay pipe. (Civil) $88,000. Client, Encinitas Sanitary District, Encinitas, Calif.

Jack B. Matson, Whittier, Calif.
Alpha Beta Market, Riverside, Calif. $250,000. Client, Alpha Beta Markets, Inc., LaHabra, Calif.

Alpha Beta Market, Costa Mesa, Calif. $225,000. Client, Alpha Beta Markets.

U.S. Marine Corps Reserve Training Center, Whittier, Calif. $300,000. Client, 11th Naval District Public Works Office, San Diego, Calif.

Garretson & Elemendorf, San Francisco, Calif.
Brass products mill, Newark, Calif. Floor area 55,000 sq ft. (Civil, struc., mech., elec.). $2,500,000. Client, Titan Brass and Metals, Bellefonte, Pa.

N. D. Whitman, Jr., Pasadena, Calif.
Woodrow Wilson Junior High School, Pasadena, Calif. Structural rehabilitation to bring 35,000-sq-ft school building up to present standards of strength and safety. (Struc.) $150,000. Client, Pasadena City High School District.

Leo W. Ruth, San Jose, Calif.
Bridge, reinforced concrete and approaches — approx. 1100 ft in length, three 100-ft spans, thirty 26-ft spans, Stanislaus River near Modesto, Calif. (Civil) $385,000. Client, Stanislaus County Board of Supervisors.

Plans and specifications for conveyor and tank removal, Riverbank Ordnance Plant. Approx. 100 tons of structural and plate steel to be removed. (Civil, mech.) $100,000. Client, Norris-Thermador Corp.

Charles J. Williams, Oakland, Calif.
Daily Review, Hayward, Calif. New newspaper plant. (Elec.) $45,000. Client, Camping Engineers, Inc.

Shopping center. (Elec.) $60,000. Client, Ted Moist, Arch.

Arthur A. Sauer, Sacramento, Calif.
Agricultural-mechanical shop and wood shop, Turlock High School, Turlock, Calif. (Struc.) $150,000. Client, Mayo, Johnson & DeWolf, Arch.

Maximum security section, San Joaquin County Jail, Stockton, Calif. (Struc.) $500,000. Client, Ernst & Lloyd, Arch.

Grace Methodist Church, Stockton, Calif. (Struc.) $100,000. Client, Ernst & Lloyd, Arch.

Classroom addition, Little Theater building, and gym addition, Vacaville High School, Vacaville, Calif. (Struc.) $350,000. Client, Koblick & Fisher, Arch.

Elverta school addition, Lincoln, Calif. (Struc.) $70,000. Client, Koblik & Fisher, Arch.

Sutter Creek Elementary School, Sutter Creek, Calif. (Struc.) $127,000. Client, Koblik & Fisher, Arch.

Mills Junior High School, Mills, Calif. (Struc.) $222,000. Client, Koblik & Fisher, Arch.

COLORADO

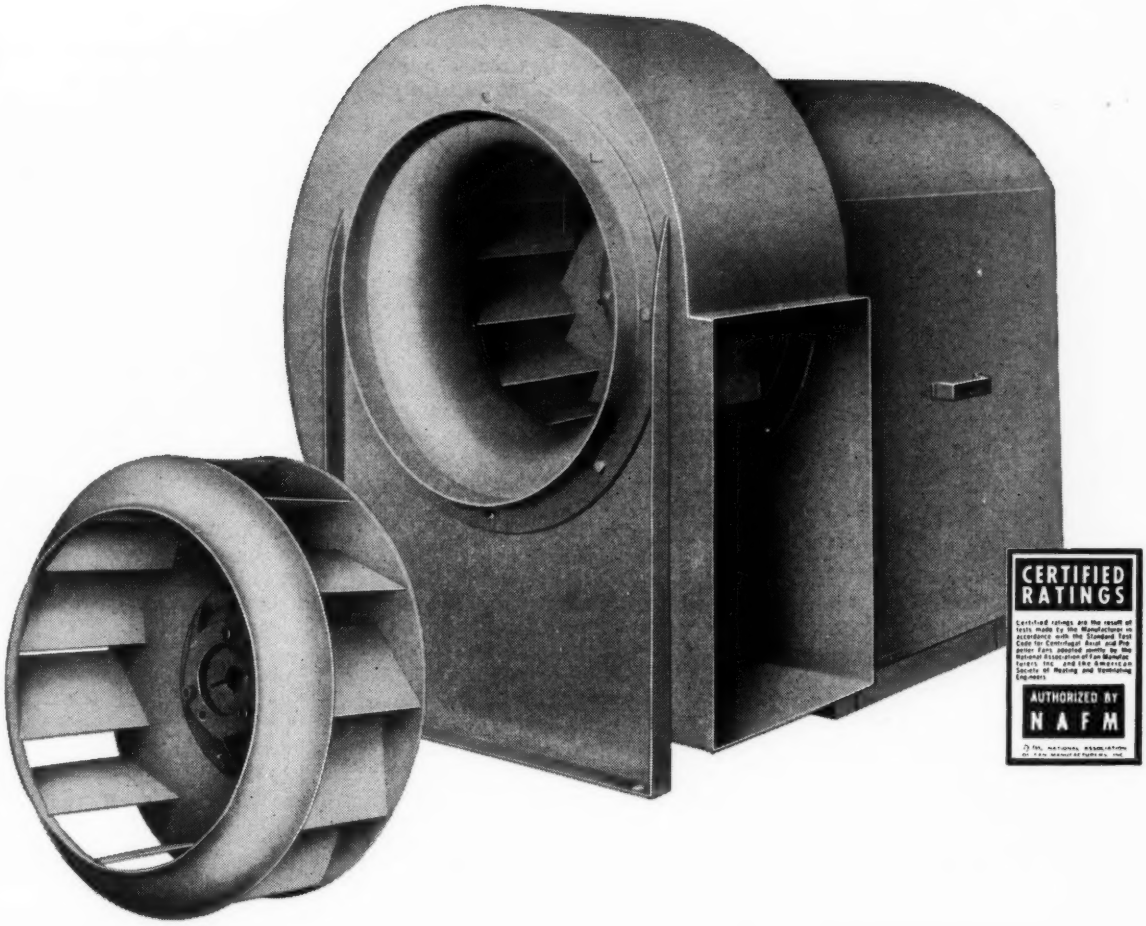
Laffoon & Woolford, Pueblo, Colo.
Preliminary estimate of acquisition cost — approx. 200 parcels commercial property — union Avenue urban renewal program, Pueblo, Colo. (Civil) $3½ million. Client, City of Pueblo and Housing & House Finance Agency.

Miner and Miner, Consulting Engineers, Inc., Greeley, Colo.
32 miles of 69-kv transmission line, Muddy Pass to Walden, Colo., with 3750 kva substation at Walden. (elec.) $275,000. Client, Mountain Parks Electric, Inc., Granby, Colo.

William H. Burgwin, Denver, Colo.
Telephone construction — 450 miles of outside plant and three central office exchanges, all located in area around Joes, Cope, and Kirk, Colo. (Civil) $300,000. Client, Plains Cooperative Telephone Assoc., Inc., Joes, Colo.

Design of interchange structure on interstate Route No. 2, Adams County, State of Colo. (Struc.) $110,000. Client, Colo. State Hwy. Dept.

K. J. Murray, Denver, Colo.
Junior high school, Denver, Colo. (Mech.) $2,000,000. Client, Gordon White, Arch.

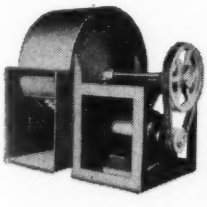


Backward Curve Blowers—Certified Ratings

Completely Designed, Engineered and Manufactured by Peerless Electric

Peerless Backward Curve Blowers are all Peerless—motor and all. We control the entire production of this versatile blower, from drawing board to finished product. We guarantee it unconditionally for quiet, trouble-free operation.

Peerless Backward Curve Blowers can be specified with confidence. They are thoroughly tested according to test codes. They meet NAFM and NEMA standards. Scores of them are operating in schools, churches, hospitals and government installations.

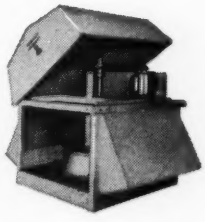


FORWARD CURVE BLOWERS

Made entirely by Peerless; arc-welded housings and frames; wheels designed for quieter operation; dynamically balanced.

CENTRIFUGAL ROOF VENTILATORS

Matching wheel cone accurately fits spun venturi for quieter, smoother air movement. All welded construction; material 16 ga. or over. Each unit air tested, and rated to assure certified PFMA ratings. Fits standard curbs.



Charter Member of the Air Moving and Conditioning Association

Peerless® Electric

FAN AND BLOWER DIVISION

THE Peerless-Electric® COMPANY

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Write Today for Bulletins SDA-220, SDA-200 and SDA-160.

a guarantee of performance:

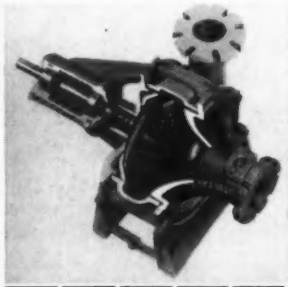
You can't clog a liquid impeller!

There is no clogging problem, because there is nothing to clog. Pumping action is caused by a *liquid* impeller, a swirling vortex of fluid.

- No constrictive impeller eye
- No constrictive discharge ports
- No wearing rings

Material flows completely unobstructed, from suction to discharge flange.

Write for complete details on the Wemco torque-flow Solids Pump and its amazing principle of operation.



WEMCO

TORQUE-FLOW

SOLIDS PUMP

WESTERN MACHINERY COMPANY

650 FIFTH STREET, SAN FRANCISCO 7, CALIF.

Ken R. White, Denver, Colo.
16 miles of 4-lane concrete highway with 8 major interchanges and a total of 24 structures. Fort Morgan to Brush, Colo. (Civil, struc.) $4,500,000. Client, Colo. State Hwy. Dept.

Ramsey & Reeves, Denver, Colo.
Apartment house for senior citizens. Six-story, 66 apartments, reinforced concrete construction. (Civil, struc., mech., elec.) $500,000. Client, Denver Area Assoc. of Christian Churches, Denver, Colo.

Church sanctuary with full basement and offices, seating for 400. (Civil, struc., mech., elec.) $83,000. Client, West Alameda Community Baptist Church, Denver, Colo.

CONNECTICUT

Julius C. Hoechel, New Haven, Conn.
Two-story clubhouse, assembly hall, playrooms, bar, kitchen. Concrete foundation, brick and block wall, 60 x 40 ft. (Civil, struc.) $60,000. Client, Antilean Club, New Haven, Conn.

F. H. McGraw & Co., New York, N.Y.
Install two-tube reducing machines, Windsor Locks, Conn. (Mech.) $300,000. Client, Hamilton Standard Propeller Co.

DISTRICT OF COLUMBIA

Consultants, Inc., Washington, D.C.
Contract for continuation of technical studies for standardization of military field refrigeration and air conditioning equipment from which Industry Advisory Committees make recommendations for standardization of operating components. Client, Office of the Quartermaster General, Research and Development Command, Dept. of Defense.

FLORIDA

Britt-Curley Assoc., Tampa, Fla.
Factory and office for Sperry Gyroscope Div., Sperry-Rand Corp., Oldsmar, Fla. (Mech., elec.) $750,000. Client, C. Dale Dykema & Assoc., N. Redington Beach, Fla.

Starlight Towers, St. Petersburg Beach, co-op apartments. (Struc., mech., elec.) $1,200,000. Client, Knox & Justice, Arch., St. Petersburg.

Sunset Villas, Treasure Island, St. Petersburg, Fla., co-op apartments. (Mech., elec.) $1,000,000. Client, C. F. McKirahan, Arch., Ft. Lauderdale.

James A. Tuck, Fort Pierce, Fla.
Industrial school at Okeechobee. (Mech., elec.) $6,000,000. Client, State of Florida.

Motel at Cocoa Beach. (Mech., elec.) $250,000. Client, Nu-Lo-Mo Corp.

Watson & Deutschman
Novitiate for Sisters of St. Joseph, Jensen Beach, Fla. Three wings, 2-story, with provisions for third story, panel type extension wall construction. $600,000. Client, Sisters of St. Joseph.

Maintenance hangar and apron for American Airmotive Corp. at Miami International Airport. 900-ft hangar with motorized doors, 120-ft cantilever truss construction, concrete apron, asphalt taxiway, underground utility stations for air, water, and electricity. $2,500,000. Client, Dade County Port Authority.

Maintenance and air freight facility. $2,000,000. Client, Riddle Airlines, Inc.

Obolor & Clarke, Miami Beach, Fla.
Exhibition hall, Miami Beach, Fla. $3,500,000. Client, City of Miami Beach.

Deauville Hotel, 550 rooms, Miami Beach, Fla. $6,000,000. Client, Melvin Grossman, Arch., Miami Beach.

Col. A. B. Jones, USA (Ret.), Miami Beach, Fla.
Investigation of beach erosion at Bahama Club, Naples, Fla. (Civil) Client, L. R. Mason.

M. R. Fellman, Miami, Fla.
Complete design of office building, Miami, Fla. $200,000. Client, Donland Realty Corp.

24-lane bowling alley, Dade County, Fla. $300,000. Client, H. Sumars.

Town Hall, Surfside, Fla. $160,000. Client, Town of Surfside.

24-lane bowling alley, Dade County, Fla. $300,000. Client, J. Solomon.

Office and tailor shop, Miami, $250,000. Client, LaVigne Uniform Co.

Jesse V. Boyles, Bartow, Fla.
Runway resurfacing, Bartow Air Base, Bartow, Fla. (Civil) $175,000. Client, Garner Aviation Service Corp.

Street construction. (Civil) $100,000. Client, City of Lake Alfred, Fla.

GEORGIA

Morris, Boehmig & Tindel, Inc., Atlanta, Ga.
Inert Manufacturing Building, Naval Ordnance Plant, Macon, Ga. Area approx. 115,000 sq ft, about 90 percent framed with folded slabs. (Struc.) $1,750,000. Client, Stevens & Wilkinson, Arch. & Engrs., Atlanta, Ga.

Science Center, University of Georgia, Athens, Ga. Four buildings, reinforced concrete frames. (Struc.) $10,000,000. Client, Associated Architects, Atlanta.

L. M. Reeves, Jr., Atlanta, Ga.
PHA housing projects, Lafayette, Ga. and Summerville, Ga. (Elec.) $50,000. Client, Ayers & Godwin, Arch., Atlanta, Ga.

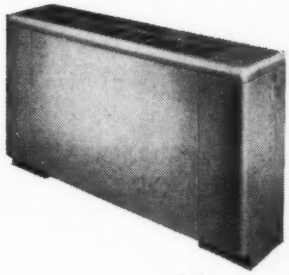
IDAHO

Cooper & Rose' & Assoc., Portland, Ore.
West Shoshone Hospital, Kellog, Idaho. Supporting floors and roof, 45,000 sq ft reinforced concrete, exterior brick face. (Struc.) $1,009,350. Client, Skidmore, Owings & Merrill, Arch.

1,245 MARLO SEAZONAIRES HEAT AND COOL MASSIVE NEW WASHINGTON APARTMENTS

Here's beauty, comfort and luxury in a big, handsome package—the new 4000 Massachusetts Avenue Apartments, Washington, D. C., with ultra-modern accommodations in 452 apartments. Owner, 4000 Massachusetts Avenue, Inc., Washington, D. C.

Air conditioned? Of course! And General Engineering Associates, engineering consultants for the project, approved Marlo Seazonaire Room Air Conditioning Units, Remote Type — 1,245 of them — to provide year-round comfort in each suite. Two Marlo Ceiling Type Air Handling Units were also specified for larger areas of the building. Total cooling capacity of all Marlo equipment is 900 tons!



Write for information about the many advantages to be found in Marlo — the quality line of equipment for every air conditioning need.

General Contractor: Standard Construction Co., Inc., Washington, D. C.

Architects: Corning and Moore, Washington, D. C.

Mechanical Contractor: W. G. Cornell Company, Washington, D. C.

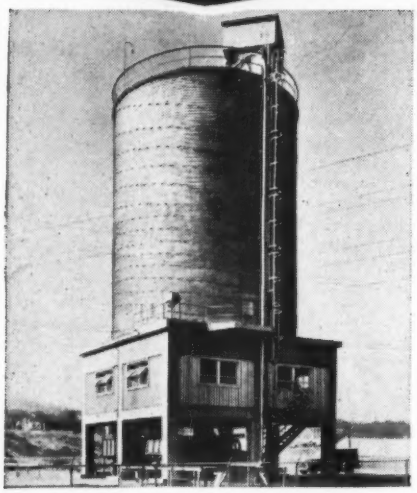
MARLO coil co.

SAINT LOUIS 10, MISSOURI

Quality Air Conditioning and Heat Transfer Equipment Since 1925

The RIGHT Answer to Your BULK STORAGE Needs:

MARIETTA CONCRETE SILOS



Whatever materials you handle . . . powder form to 16" lumps . . . you can realize a big savings in time, labor and money with a MARIETTA storage system designed to your operation.

Marietta silos are economically erected in any desired capacity . . . any number of units. Interlocking concrete stave construction provides safe, dry storage . . . resists wind, shock or fire . . . requires a minimum of maintenance.

Conveyors, feeders, discharge systems or other auxiliary equipment for your particular material handling requirements can be mounted on the sturdy walls of a Marietta silo.

Depend on Marietta's 41 years of experience to design and erect the most efficient storage system for your need under one cost-saving contract. No delays due to critical material shortages with a Marietta installation . . . erection is quickly and efficiently handled by factory trained personnel.

Write for Marietta's Modern Industrial Storage Systems Booklet and the right answer to your bulk storage problems.

THE Marietta CONCRETE CORPORATION Marietta, Ohio

41 Years Know-How in Pre-Cast Concrete Construction

BRANCH OFFICES: Baltimore 21, Md., Charlotte 6, N.C., Nashville, Tenn., Jamestown, N.Y.

Carroll Wilcomb, Jerome, Idaho.
Local Improvement District No. 9. (Civil) $100,000. Client, City of Jerome.

ILLINOIS

F. H. McGraw & Co., New York, N.Y.
Extension to plant, Madison, Ill. (Civil, struc.) $550,000. Client, Dow Chemical.

INDIANA

Riley Shuttleworth, Indianapolis, Ind.
Office building for Wabash Fire & Casualty Insurance Co., Indianapolis, Ind. (Mech., elec.) $115,000 (Mech.), $13,000 (Elec.), $640,000 (Total building cost). Client, Edward D. James & Assoc., Inc., Indianapolis, Ind.

F. H. McGraw & Co., New York, N.Y.
Rehabilitation of building and installation of paper mill, Hartford City, Ind. (Struc., mech.) $1,500,000. Client, Ebasco Services, Inc.

Switch gear distribution apparatus plant, Bloomington, Ind. (Civil, struc.) $3,245,000. Client, Westinghouse Elec.

J. Stephen Watkins Consulting Engineers, Lexington, Ky.
Design and construction plans for 7.5 miles of interstate highway near Shelbyville. (Civil, struc.) $4,500,000. Client, Indiana State Hwy. Dept.

IOWA

Frank L. Pulley, Des Moines, Iowa.
YMCA, Des Moines, Iowa. (Mech., elec.) $2,500,000. Client, Wetherell & Harrison.

KANSAS

Hefling Engineering Co., Hutchinson, Kans.
Sewage treatment plant. (Civil) $1,500,000. Client, City of Hutchinson.

Raymond H. Reed & Co., Columbus, Nebr.
8 miles 34.5-kv transmission line and 35 mi. distribution line in Norton County, Kans. (Elec.) $65,000. Client, Norton-Decatur Electric Co-op., Inc., Norton, Kans.

Paden & Bartlett, Topeka, Kans.
Hill Valley Water Coop., wells and system water supply. (Civil) $275,000. Client, Hill Valley Water Co.

Washburn Street paving and drainage structures. (Civil) $200,000. Client, City of Topeka, Kans.

KENTUCKY

J. Stephen Watkins Consulting Engineers, Lexington, Ky.
Plans, specifications, and supervision of construction of 20 mgd pumping stations and 30 and 16-in. pipe line. (Civil, struc., mech., elec.) $359,000. Client, U.S. Atomic Energy Comm.

Plans, specifications, and supervision of construction of 0.9 mgd sewage treatment plant and outfall sewers. (Civil, struc., mech., elec.) $377,200. Client, City of Synthiana, Ky.

Plans, specifications, and supervision of construction of 1 mgd addition to water treatment plant. (Civil, struc., mech., elec.) $128,000. Client, City of Danville, Ky.

Plans and specifications for sewerage system improvements. (Civil, struc., mech., elec.) $137,500. Client, City of Danville, Ky.

Plans and specifications for new mgd water treatment plant, new mgd sewage treatment plant, water line extensions, and sewerage system additions. (Civil, struc., mech., elec.) $1,250,000. Client, City of Pikeville, Ky.

LOUISIANA

J. J. Krebs & Sons, New Orleans, La.
350-lot subdivision to be located near New Orleans. Land planning and all off-site improvements. (Civil) $315,000. Client, Clarence Foret, Westwego.

Completion of plans and specifications for Unit No. 1 of "Godchaux Community" proposed subdivision in St. John the Baptist Parish, La. $450,000. Client, Mississippi River Dev. Corp.

Sewage treatment plant for "Godchaux Community" subdivision. $60,000. Client, Mississippi River Dev. Corp.

Val A. Lyons, Civil Engineer, Shreveport, La.
Structural drawings for grocery and market, Shreveport. (Struc.) $30,000.

MAINE

Francis J. Linehan, Jr., Boston, Mass.
New bank building for Keenebec Savings Bank, Augusta, Me. (Mech.) $235,000. Client, Hutchins & French, Arch.

MARYLAND

Henry Hagel, Baltimore, Md.
Industrial plant. 2 bays, 40-ft wide, 1 bay, 60-ft wide, 500-ft long. Steel frame, protective metal siding. (Struc.)

MASSACHUSETTS

Francis J. Linehan, Jr., Boston, Mass.
New bank building for Guaranty Bank and Trust Co., Worcester, Mass. (Mech.) $350,000. Client, Hutchins & French, Arch.

New Roman Catholic Church, Hingham, Mass. (Mech., elec.) $275,000. Client, Mario V. Caputo, Arch.

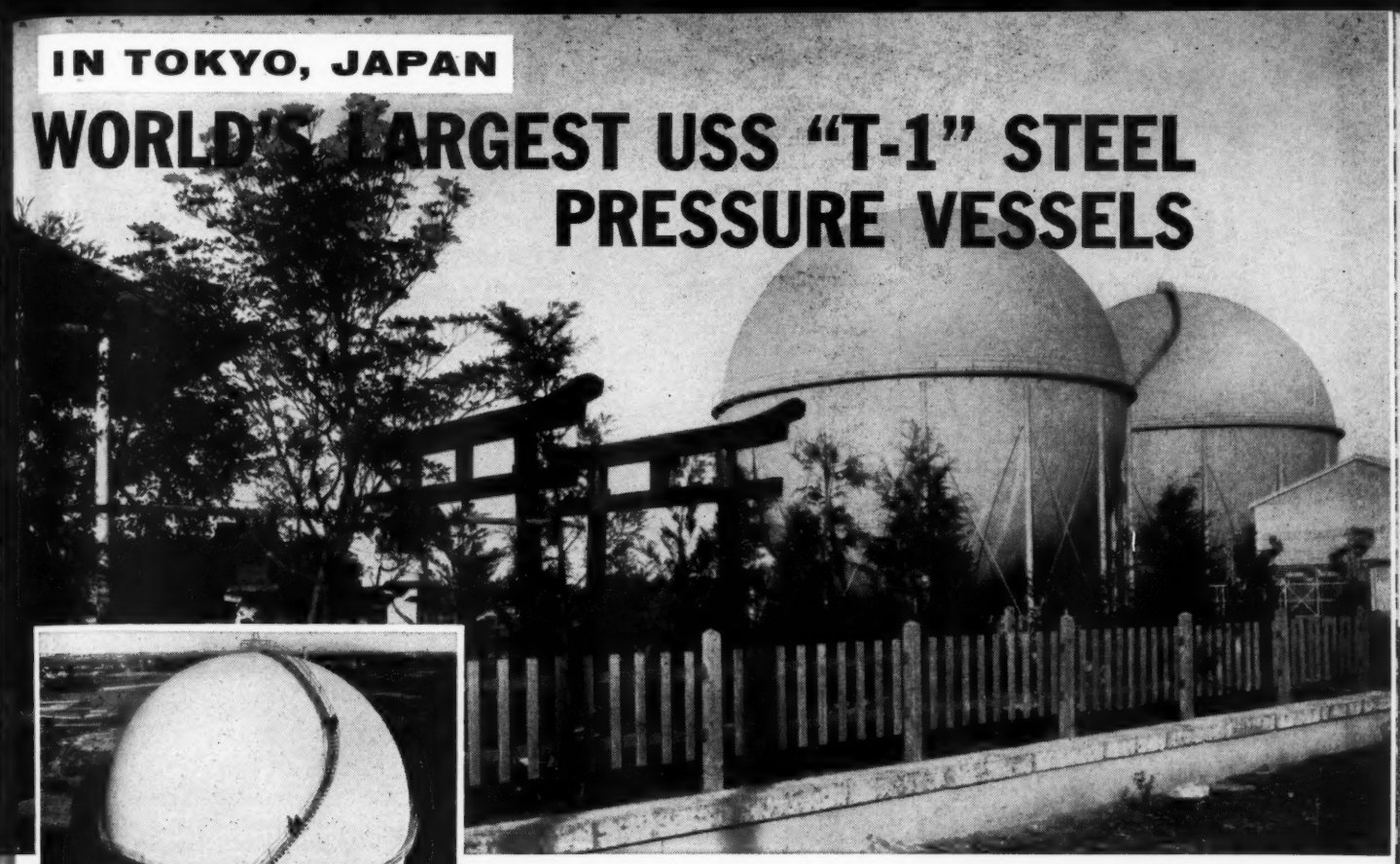
Hooper & Souza, Boston, Mass.
Russell St. School, Woburn, Mass. (Struc.) $400,000. Client, Edward J. Tedesco.

Greek Orthodox Church, Woburn, Mass. (Struc.) $100,000. Client, Edward J. Tedesco.

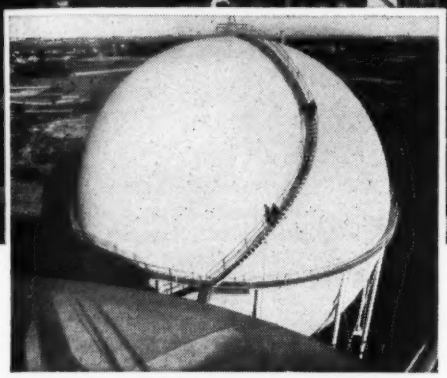
R.O.T.C. building, University of Massachusetts, Amherst. (Struc.) Client, Clinton Foster Goodwin.

IN TOKYO, JAPAN

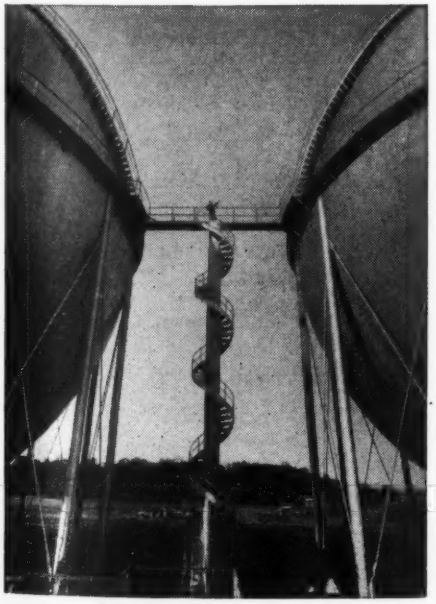
WORLD'S LARGEST USS "T-1" STEEL PRESSURE VESSELS



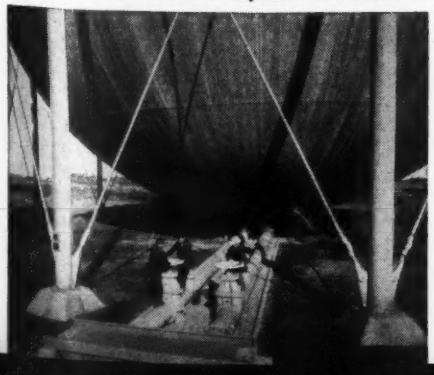
Beyond the Shinto shrine are the two USS "T-1" Steel spheres. They are being used by Tokyo Gas Works, Ltd., for the storage of natural gas at a pressure of 71.1 psi.



Lightweight construction—made possible by USS "T-1" Steel—cut shipping, handling and erection costs of these giant pressure vessels.



Thinner walls meant less weld metal required, less erection time needed. Lightweight construction also reduced amount and expense of foundation.



COMPARED TO CARBON STEEL CONSTRUCTION, the use of USS "T-1" Steel saved 1,720 tons of steel in the two giant pressure vessels pictured here. Having a diameter of 110.5 ft. each, they are the largest Hortonspheres ever built for the storage of gas. USS "T-1" Steel enabled Chicago Bridge & Iron Company to use 0.73-inch-thick shell plates rather than mild steel plates 1.75 inches thick.

USS "T-1" Steel's very high yield strength (90,000 psi minimum), plus previous experience in building non-code government vessels, permitted use of a maximum allowable working stress of 36,000 psi to which a 90% weld joint efficiency was applied. With the exception of the working stress values, the vessels were built to the ASME Code for Unfired Pressure Vessels where applicable.

In addition to saving 1,720 tons of steel, the thinner USS "T-1" Steel plates drastically lowered the cost of shipping to Japan. And each ton saved meant lower erection, welding and foundation costs. Added up, all these savings point out why the use of USS "T-1" Steel spells economy.

Shell plates were fabricated at CB&I's Greenville, Pa. plant and shipped to Tokyo for field erection. Field welding was done with E 12016 electrodes and did not require stress relief. All welds were 100% X-rayed.

Two additional vessels of similar design, but smaller in size, are now being fabricated by Chicago Bridge & Iron for installation in Tokyo.

USS "T-1" Steel is being used to improve performance and reduce costs in a wide variety of applications in steel mills, in mining equipment, in construction equipment, in materials handling equipment, in bridges, and even in steam turbines. Write for complete information about its application and fabrication. United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

USS "T-1" CONSTRUCTIONAL ALLOY STEEL

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UNITED STATES STEEL

Watch the **United States Steel** Hour on TV every other Wednesday (10 p.m. Eastern time).

USS

ATTENTION CLEVELAND!

Clevelander eradicates Mr. Entropy*— stops steam waste with SELECTOTHERM

Around Cleveland, Don Shanck, 412 Superior Avenue, is famed for getting rid of steam waste in schools and other buildings where boilers are used for steam heating.

He does it with SELECTOTHERM, the high-vacuum heating system that automatically provides steam at the proper pressure and temperature for perfect comfort. Installation records show that SELECTOTHERM cuts the fuel bill 19% or more—*enough to pay for the system within five years!*

SELECTOTHERM applies the control directly to the boiler, adds to the effectiveness of unit ventilators and individual room control. Get the whole story. If you're from the Cleveland area, call Don at American Air Filter Company, Inc., (Main 1-1523). If not, write for fact-filled SELECTOTHERM booklet, *Boiler Room Ballad.*

* *Mr. Entropy represents the heat that is produced but unavailable for use.*

SELECTOTHERM
HEATING CONTROL SYSTEM ®

A product of Illinois Engineering Co.
Division of American Air Filter Co., Inc.
2035 South Racine Ave., Chicago 8, Illinois

Armenian Holy Trinity Church, Cambridge, Mass. (Struc.) $500,000. Client, John S. Bilzerian.

MICHIGAN

Donker Engineering Co., Grand Rapids. Six-story split level parking ramp for approximately 375 cars. (Civil, struc., mech., elec.). $900,000. Client, Grand Rapids Municipal Parking Authority.

Storm sewer for Grandville, Mich. (Civil). $165,000. Client, Grandville.

Ken Fishbeck, Lansing, Mich.
Storm sewer system, Huntington Acres subdivision, Delta Township, Eaton County. (Civil). $100,000. Client, Burton Jones Development Co.

Investigation for sanitary sewer system and sewage treatment, Meridian Township. Client, Ingham County Road Commission.

Harry J. Fuller, Mount Clemens, Mich. Concrete street paving. (Civil). $800,000. Client, City of East Detroit.

Concrete street paving. (Civil). $170.000. Client, Village of Roseville.

The Francis Engineering Co.
Plans for watermain extensions, including new sources of supply. (Civil). $180,000 (est.) Client, Zilwaukee Township, Saginaw County, Mich.

Watermain extensions. (Civil). $145,000 (est.). Client, Saginaw Township, Saginaw County, Mich.

Sewage treatment plant. (Civil). $70,000 (est.). Client, Village of Elberta.

Prepare plans for watermain extensions (Civil). $85,000. Client, Saginaw Township, Saginaw County, Mich.

Johnson & Anderson, Inc., Pontiac, Mich. Trunk sewers. (Civil) $4,000,000. Client, Genesee County Sew. Disp. Dist.

Lateral sewers. (Civil) $4,000,000. Client, Genesee County Sewage Disposal District.

Water distribution system, including storage. (Civil) $7,000,000. Client, Waterford Township, Oakland County.

Medema, Van Kooten & Assoc., Grand Rapids, Mich.
Manufacturing and office building, 100 x 275 ft, steel frame construction, Paris Township, near Grand Rapids, Mich. (Struc.) $200,000. Client, Superior Machine & Tool Inc.

Michigan Associates, Lansing, Mich.
Northwest Highway, 14 bridges. $2,500,000. Client, Michigan State Hwy. Dept.

Three state police buildings. $300,000. Client, Michigan State Police Headquarters.

Two water supply systems. $300,000. Client, Ashley & Dimondale.

Sewage study. $100,000. Client, Post Cereals, Battle Creek, Mich.

T. Marvin Sahlin, Benton Harbor, Mich. Northwest Elementary School, Kalamazoo, Mich. $100,000 (Mech. only). Total cost $525,000. Client, Architect.

YWCA addition, St. Joseph, Mich. $75,000 (Mech. only). Total cost $350,000. Client, YWCA Board.

Central fire station, Kalamazoo, Mich. $50,000 (Mech. only). Total cost $200,000. Client, Architect.

Remodel First National Bank, Niles, Mich. $15,000 (Mech. only). Total cost $100,000. Client, bank and architect.

J. Stephen Watkins Consulting Engineers, Lexington, Ky.
Survey, design, and construction plans for approx. 18 miles of interstate highway near Battle Creek. (Civil, struc.) $12,000,000. Client, Michigan State Hwy. Dept.

Survey, design, and construction plans for approx. 7.7 miles of primary road near Battle Creek. (Civil, struc.) $6,200,000. Client, Mich. State Hwy. Dept.

Williams and Works, Grand Rapids. Design and construction of water supply system, including new Lake Michigan collector type intake, water treatment plant, storage, and water mains. (Civil) $300,000. Client, City of Bridgman, Mich.

Improvements to sewage treatment plant. (Civil) $25,000. Client, City of Alma, Mich.

Sewage treatment plant. (Civil) $100,000, Client, Evart, Mich.

Storm sewer system. (Civil) $1,300,000. Client, Grand Haven, Mich.

MINNESOTA

L. E. Lane, Willmar, Minn.
Drainage, curb, and gutters and bituminous pavement for entire village. (Civil) $46,000. Client, Village of Kandiyohi, Minn.

K. B. MacKichan & Assoc., Grand Forks and Minot, N.D.
Reconstruction of electrical distribution system at Newfolden, Minn. $20,000. Client, Village of Newfolden.

Mayeron Engineering Co., Minneapolis. Olmsted County Court House, 3-story, continuous reinforced concrete. (Struc.) $1,500,000 (est.) Client, Daniel Robbins & Associate, Arch.

Schoell and Madson, Minneapolis, Minn. Investigation and report for new municipal water supply and distribution system. (Civil) $570,000. Client, Village of Island Park, Minn.

MISSISSIPPI

Titlestad Corp., New York, N.Y.
Design 600 ton per day contact type, single unit, sulfuric acid plant, Pascagoula, Miss. (Chem., struc., mech., elec.) $2,000,000. Client, Coastal Chemical Corp., Yazoo City, Miss.

All-welded feedwater heater for new generating station will operate at 3200 psi with inlet steam temperature of 678° F. Designed and fabricated by The Lummus Company, the unit is the first of its kind, is also the biggest heater ever built for operation at pressures above 3000 psi, having 12,710 square feet of tube surface in a single shell.

First All-Welded Feedwater Heaters Will Cut Generating Station Maintenance Costs

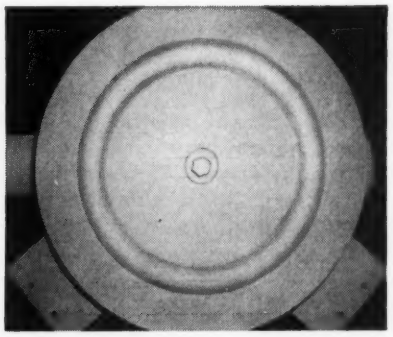
The first all-welded feedwater heaters ever built have been designed and fabricated by Lummus for the Linden Generating Station of the Public Service Electric and Gas Company of New Jersey. When completed, the installation will include 6 all-welded heaters, designed to operate at pressures well above 3000 psi, and 12 low pressure heaters which were all welded except for the tube to tube sheet joints.

In addition, Public Service has just given Lummus a contract to supply feedwater heater requirements for their new Bergen Generating Station, duplicating in design the Linden units.

Welded construction minimizes leaks in tubes, shell and head. Thus the new units are expected to reduce materially the costly maintenance and downtime associated with failure of seals in bolted and gasketed constructions.

These unique heaters are the end result of over ten years of design and experimental work by The Lummus Company with all-welded fabrication. Perhaps this pioneering can help you reduce maintenance problems, too. For more information write The Lummus Company, 385 Madison Avenue, New York 17, New York.

Ends of cupro-nickel tubes are jointed to steel tube sheet by Inco "140" Monel Ni-Cu alloy electrodes. This alloy fuses well with both tube and sheet materials, forms strong, sound joint.



Closed head shows torus ring seal which is welded to channel and cover. Gasketed joint has been eliminated to avoid possibility of leakage. Design water pressure of unit is 3600 psi.

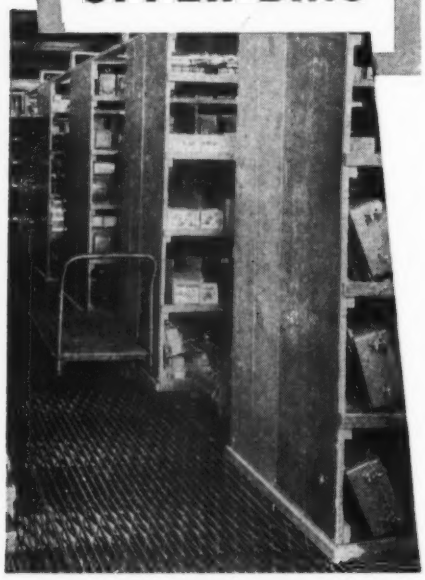
LUMMUS

HEAT EXCHANGER DIVISION

THE LUMMUS COMPANY, Heat Exchanger Division, 385 Madison Avenue, New York 17, N. Y.
Atlanta • Boston • Chicago • Cincinnati • Cleveland • Dallas • Denver • Detroit • East Chicago (Indiana) • Houston • Kalamazoo • Kansas City • Los Angeles • Memphis • Minneapolis Nashville • New Orleans • Newton (Iowa) • Niskayuna (New York) • Omaha • Pittsburgh Salt Lake City • San Francisco • Springfield (Mass.) • Syracuse • Toledo • Wayne (Pa.) • Athens Buenos Aires • Caracas • The Hague • Lima • London • Mexico City • Montreal • Paris Rome • San Juan

Steam Surface Condensers • Evaporators • Extraction Bleeder Heaters • Steam Jet Air Ejec ors Steam Jet Refrigeration • Barometric Condensers • Heat Exchangers for Process and Industrial Use • Process Condensers • Pipe Line Coolers

Mezzanine GIVES SAFE ACCESS TO UPPER BINS



To solve the storage problem in this plant, storage bins along two walls were extended to the ceiling. But to reach the upper level of bins, it was necessary to use a long hazardous ladder.

Safe and easy access was achieved by installing a mezzanine made of open metal grating, midway between the ceiling and the floor. The mezzanine is reached via a stairway also made of grating.

Irving Grating and Treads not only provide a sure-footed walking area of strength and durability but also allow light to pass and air to circulate freely.

Manufacturers of Riveted, Welded, Pressure-Locked Gratings in Steel, Aluminum and other metals.

Write today for General Grating Catalog

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IRVING SUBWAY GRATING CO., Inc.
***Originators* of the Grating Industry**

Offices and Plants at
5056 27th St., LONG ISLAND CITY 1, N. Y.
1856 10th St., OAKLAND 23, CALIFORNIA

MISSOURI

Dwyer, Sanders & Kite, Kansas City, Mo.
Structural design for 45,700 sq ft classroom unit, plus 14,000 sq ft dining and multi-purpose unit for Parkhill High School, Parkville, Mo. $500,000 (est.) Client, V. Preston Terrell, Arch.

Structural design, gymnasium and physical education building for Warrensburg College, Warrensburg, Mo. $250,000 (est.) Client, V. Preston Terrell, Arch.

Allgeier, Martin & Assoc., Joplin, Mo.
Water system. $90,000. Client, Duenweg, Mo.

Water system improvements. $110,000. Client, Seneca, Mo.

Leon Maslan & Co., Kansas City, Mo.
Meadow Lake Shopping Center, Kansas City, Mo. Group of one-story commercial buildings. (Struc.) $2,000,000. Client, Herbert Duncan, Arch.

NEBRASKA

Raymond H. Reed & Co., Columbus, Nebr.
Five substations, 34.5/12.5 kv, and 65 mi transmission line. Lancaster and Gage Counties, Nebr. (Elec.) $350,000. Client, Norris Rural Public Power District, Beatrice, Nebr.

Two substations and 12 mi 34.5-kv transmission line in Hall and Hamilton Counties, Nebr. (Elec.) $130,000. Client, Southern Nebr. Rural Public Power District, Grand Island, Nebr.

200 miles distribution line to connect 400 irrigation wells in Hall and Merrick Counties, Nebr. (Elec.) $220,000. Client, Southern Nebraska Rural Public Power District, Grand Island, Nebr. 9.4 miles 34.5-kv transmission line in Howard County, Nebr. (Elec.) $38,000. Client, Howard-Greeley Rural Public Power District, St. Paul, Nebr.

NEW MEXICO

Blum & Guerrero, Dallas, Texas.
School and teacherage, Dulce, N.M. (Mech., elec.) $600,000. Client, Walgamoode & Millington, Arch., Santa Fe, N. M.

J. L. Breese & Assoc., Santa Fe, N.M.
Presbyterian summer camp, Abiquiu, N.M. Sewage and water system, interior plumbing for Phase 1, cottages and group lodges. (Mech.) $380,000. Client, W. T. Harris, Arch., Hobbs.

Shiprock elementary school, Shiprock, N.M. Heating and plumbing. (Mech.) $150,000. Client, Garland & Phillippe, Architect & Engineers, Farmington.

Santa Fe Music Pavillion. Sewage disposal and water system, interior plumbing and heating. (Mech.) $65,000. Client, McHugh & Hooker, Arch., Santa Fe, N.M.

Bridgers & Paxton, Albuquerque, N.M.
Laboratory building for Lovelace Clinic, 4 floors, 24,000 sq ft. (Mech.) Client, Ferguson-Stevens, Arch., Albuquerque, N.M.

Office building, Farmington, N.M. 6 stories and basement, air conditioned. (Mech.) $1,500,000. Client, Pierce, Norris, McCutcheon & Pace, Arch., Midland, Texas.

Branch bank, Bank of New Mexico, Albuquerque. (Mech.) $200,000. Client, W. C. Kruger, Arch., Santa Fe, N.M.

John Adams Junior High School, Albuquerque, N.M. (Mech.) $500,000. Client, Stanley & Wright, Arch., Albuquerque, N.M.

NEW JERSEY

Paul K. Gerhardt, Englewood, N. J.
Catholic hospital, St. James, Newark, N.J. (Mech., elec.). $3,000,000. Client, Anthony DePace, Arch.

Catholic regional high school, Norwalk, N.J. (Struc., mech., elec.). $2,000,000. Client, Anthony DePace, Arch.

Melvin H. Friedman & Assoc., Bergenfield, N.J.
New factory building 54,000 sq ft, forced hot water heating system using baseboard heat and down-blow unit heaters. Phillips Realty Co., Clifton, N.J. (Mech., elec.). Client, Sidney Schenker, Arch., Paterson, N.J.

Albert C. Jones Assoc., Mount Holly, N.J.
Design, supervision, and construction of sewage treatment plants, collecting lines, and appurtenances. (Civil) $1,200,000. Client, Cinnaminson Township Sewerage Authority, Cinnaminson, N.J.

Additions and improvements to existing sewage treatment plant and appurtenances. (Civil) $600,000. Client, City of Millville, N.J.

F. H. McGraw & Co., New York, N.Y.
New facilities at E. R. Squibb plant, New Brunswick, N.J. (Civil, struc., mech.) $7,000,000. Client, Olin Mathieson Chemical Corp.

Two catapults, Lakehurst, N. J. (Mech.) $650,000. Client, E. W. Bliis Co.

NEW YORK

Donald E. Brill, P.E., Williamsville, N.Y.
Site development, Akron High School. $80,000. Client, School Board.

Junior and senior high school, Lackawanna, N.Y. $3,200,000. Client, J. R. Edgar, Arch.

Suburban motel, Cheektowaga, N.Y. $400,000. Client, Richard Maides, Arch.

Industrial plant expansion. Client, Pivot, Punch & Die Corp.

Grade school addition. $560,000. Client, J. R. Edgar, Arch.

Brown and Matthews, New York, N.Y.
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Kansas City, Mo., 6 East 11th St., **BAltimore 1-8892**
Minneapolis 4, Minn., 708 S. 10th St., **FEderal 9-8875**
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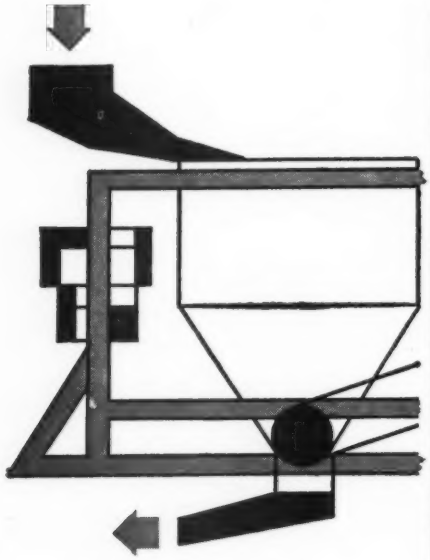

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of brick, concrete, and steel with automatic sprinklers and air conditioning. Client, Servomechanisms, Inc., New York City.

John C. Carlisle & Assoc., New York. Housing project, New York City. 14 buildings on 4 city blocks. Super market, drug store, and 24 small miscellaneous stores. Central power plant consisting of eight 300-hp boilers. (Mech., elec.) $23,000,000. Client, New York City Housing Authority and Holden, Egan, Wilson & Corser, Arch.

Melvin H. Friedman & Assoc., Bergenfield, N.J.
New office building, 6500 sq ft, 30-ton air conditioning, hot water baseboard heat, lighting at 35 ft candles. Kay-Fries Chemical Co., West Haverstraw, N. Y. (Mech., elec.). Client, Schofield & Colgan, Nyack, N.Y.

Galson and Galson, Syracuse, N.Y.
Office and warehouse building. Air conditioning, heating, ventilating, electric, and sanitation. 70,000-sq-ft air conditioned space, 100 TR absorption unit, chilled water air conditioning system, steam generation, gas fired. (Mech., elec.) $250,000. Client, Syracuse Supply Co. and Carl W. Clark, Arch., Syracuse, N.Y.

Paul K. Gerhardt, Englewood, N.J.
Doctors Hospital, Bronx, N.Y. (Mech., elec.). $1,200,000. Client, Anthony DePace, Arch.

Lester C. Hehn—Engineering, Port Washington, N.Y.
Design new one-story 3000-sq-ft research and development laboratory, Port Washington, N.Y. $20,000 (est.). Client, Joseph Hehn, Jr., Builder, Port Washington.

F. H. McGraw & Co., New York, N.Y.
Pilot plant for manufacturer of rocket fuel, Niagara Falls, N.Y. (Civil, struc., mech.) $3,500,000. Client, Olin Mathieson Chemical Corp.

Dismantle two presses at Albany, N.Y. and re-erect at Topeka, Kans. (Mech.) $75,000 (est.) Client, Capper Publications, Inc.

NORTH CAROLINA

Campbell & Leppard, Greenville, S.C.
Garment manufacturing plant, Hendersonville, N.C. (Mech., elec.) $90,000. Client, William H. O'Cain, Arch.

NORTH DAKOTA

K. B. MacKichan & Assoc., Grand Forks and Minot, N.D.
Water treatment plant at Rugby, N.D. 750,000 gpd, complete treatment. Concrete treatment basins, masonry building. $250,000. Client, City of Rugby.

Sewerage system and waterworks at Lansford, N.D. Complete system, stabilization lagoon, 50,000 gal overhead storage. $170,00. Client, Lansford.

Water treatment plant at Park River, N.D. 500,000 gpd, complete treatment, steel fabricated basins, remodeling existing building. $100,000. Client, City of Park River.

George J. Toman, Mandan, N.D.
Paving, curb, and gutter for 120 blocks. $450,000. Client, Wishek, N.D.

Sewage lagoon. $22,000. Client, Mohall.

Sewage lagoon. $8000. Client, Westhope.

Sewage lagoon. $12,000. Client, Underwood, N.D.

OHIO

DeLeuw, Cather & Brill, New York, N.Y.
Preliminary studies for alignment, profile, and structures for 64-mile bypass around the City of Columbus, Ohio. (Civil). Client, State of Ohio Dept. of Hwys.

Helmig, Lienesch & Assoc., Dayton.
Butler Township high school, Vandalia, Ohio. (Mech., elec.) $1,100,000. Client, W. W. Wurst, Arch.

100-bed children's psychiatric hospital. (Mech., elec.) $1,500,000. Client, W. W. Wurst, Arch.

OKLAHOMA

Alexander Engineering Co., Oklahoma City, Okla.
Mechanical and concrete design of Chickasha water supply additions. $85,000. Client, M&M Construction Co.

OREGON

Cooper & Rose' Assoc., Portland, Ore.
YWCA building, Portland, Ore. 67,500 sq ft supporting floors and roof. 5-story, fireproof concrete and structural steel. Club rooms, swimming pool, and recreation. Designed for 5 future stories. (Struc.) $1,207,748. Client, Stanton, Boles, Maguire & Church, Arch.

Marshall, Barr & Assoc., Seattle, Wash.
Truck dump and alterations to Quaker Oats plant, Portland, Ore. (Struc., mech., elec.) $300,000. Client, Continental Grain Co.

PENNSYLVANIA

Gibbs & Hill, Inc., New York, N.Y.
Design new transmission circuits, modify existing structures to carry wires, and design new structures for 51 circuit miles of 132-kv transmission lines along 43 miles of Pennsylvania Railroad right-of-way. Client, Philadelphia Electric Co.

Glace & Glace, Inc., Harrisburg, Pa.
Complete sanitary sewerage system and sewage treatment plant. Greencastle, Pa. $965,000. Client, Greencastle, Franklin County, Authority.

Construct new sewage treatment plant of high rate filter type with capacity of 3 million gal. Carlisle. $850,000. Client, Borough Sewer System Authority.

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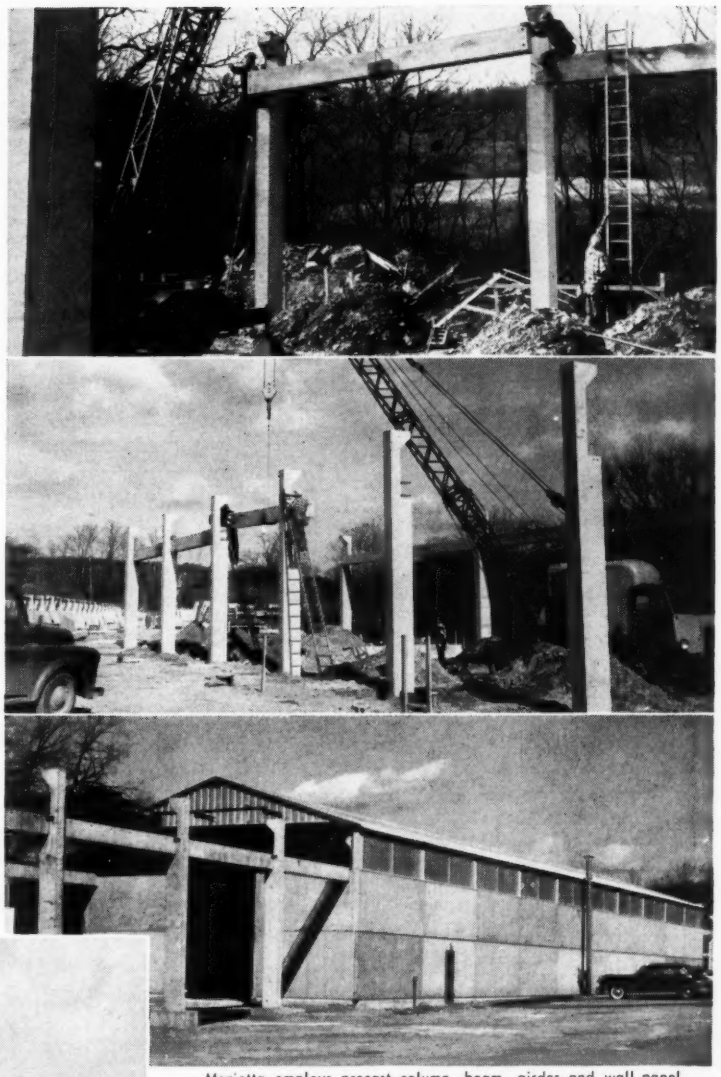

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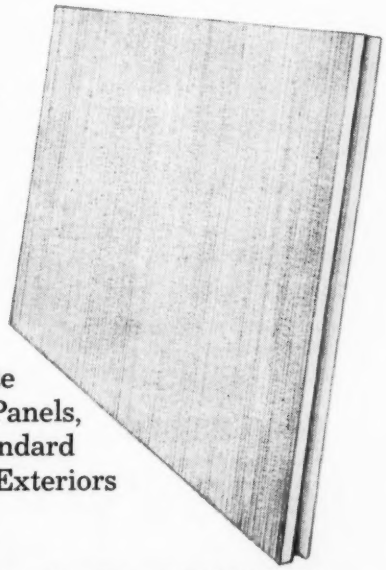
Modern architectural beauty is achieved with Marietta precast wall panel construction in a Nashville, Tenn. shopping outlet



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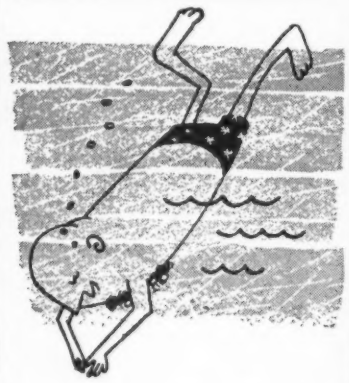

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RHODE ISLAND

Castellucci & Galli, Pawtucket, R.I.
Supermarket, East Greenwich, R.I. (Struc., mech., elec.) $250,000. Client, Community Food Centers, Inc.

C. Richard Ortoleva, Providence, R.I.
Two-story store and basement, 104 x 35 ft. 12-in. stonecrete block walls, front, crab orchard, hot water heat, steel beams, wood joist, Providence, R.I. (Civil, struc., mech., elec.) $80,000. Client, Samuel Elman.

SOUTH CAROLINA

Campbell & Leppard, Greenville, S.C.
Memorial Auditorium, Greenville, S. C. (Mech., elec.) $375,000. Client, Cunningham & Walker, Arch.

Textile mill, Anderson, S.C. (Mech.) $75,000. Client, J. P. Stevens & Co.

Physics building, Clemson College, S.C. (Mech., elec.) $250,000. Client, Hopkins, Baker & Gill, Arch.

SOUTH DAKOTA

Brady Engineering, Spearfish, S.D.
Sewer outfall, lift station, and stabilization pond. (Civil) $87,000. Client, City of Edgemont, S. D.

550,000-gal steel water reservoir. (Civil) $42,000. Client, City of Lemmon. S.D.

Black Hills Teachers College football stadium. (Civil) $45,000. Client, Black Hills Teachers College Alumni Assoc., Spearfish, S.D.

TENNESSEE

Barge, Waggoner & Sumner, Nashville.
Utility improvement program: extensions to sewerage system; enlarge sewage treatment plant; reinforce water distribution system; new raw water pumping station; and new 500,000-gal elevated, steel storage tank. $750,000. Client, Town of Manchester, Tenn.

L. M. Reeves, Jr., Atlanta, Ga.
Four-story dormitory, approx. 35,000 sq ft, Fisk University, Nashville, Tenn. (Elec.) $25,000. Client, Ayers & Godwin, Arch., Atlanta, Ga.

All Saints Chapel, University of South Sewanee, Tenn. (Elec.) $30,000. Client, Ayers & Godwin, Arch., Atlanta, Ga.

J. Stephen Watkins Consulting Engineers, Lexington, Ky.
Survey, design, and construction plans for approx. 30 miles of interstate highway from Jellico to Vasper. (Civil, struc.) $10,500,000. Client, Tennessee State Hwy. Dept.

TEXAS

Blum & Guerrero, Dallas, Texas.
High school, Henrietta, Texas. (Mech., elec.) $800,000. Client, White & Feinberg, Arch.

Offices, Moore Business Forms, Denton, Texas. (Mech., elec.) $300,000. Client, Bennett and Crittenden, Arch.

Shopping center, Dallas "Big Town." (Mech., elec.) $10,000,000. Client, Tatum & Quade, Architects & Engineers, Genri Von Frellich, developer.

Miles F. Wortham & Assoc., Houston.
Office and warehouse. 15,000 sq ft, dock high, reinforced concrete foundation, walls, and floor slab; prestressed girders and roof deck, masonry front, planters, steel canopy. Plaster partitions and suspended acoustic ceilings. (Civil, struc., mech., elec.) $100,000. Client, Warren Electric Co., Beaumont.

VIRGINIA

Clarkeson Engineering Co., Washington.
Recommended location study of interstate route from Fredericksburg to Woodbridge, Va., including approximate cost. (Civil, struc.) Client, Virginia Hwy. Dept., Richmond, Va.

WASHINGTON

Carey & Kramer, Seattle, Wash.
Iron removing water filter plant for 24 mgd, using pressure aeration and pressure filters. (Civil) $1,600,000. Client, City of Anacates, Wash.

Design of dry dock for Puget Sound Navy shipyard at Bremerton, Wash. joint venture with Moran, Proctor, Mueser & Rutledge, New York City. (Mech., elec.) $40,000,000. Client, Navy.

Marshall, Barr & Assoc., Seattle, Wash.
Warehouse building, Seattle, Wash. (Struc., mech., elec.) $125,000. Client, M. Bloch & Co.

Coal loading facilities, Port of Seattle, Wash. (Struc., mech., elec.) $125,000. Client, Port of Seattle.

William M. Valentine.
Add air conditioning to three floors of older building of Washington Athletic Club at Seattle, Wash. (Mech., elec.) $100,000. Client, Washington Athletic Club and Howard S. Wright & Co.

WEST VIRGINIA

F. H. McGraw & Co., New York, N.Y.
Power piping installation, Krammer station, Cressup, W. Va. (Mech.) $2,750,000. Client, American Gas & Electric Company.

WYOMING

Brady Engineering, Spearfish, S. D.
Improvements to Mondell Airport — widening and lengthening runway at Newcastle, Wyo. (Civil) $64,000. Client, Newcastle, Wyo. and Weston County.

Ken R. White, Denver, Colo.
Office building for Wyoming State Highway Dept., Cheyenne, Wyo. (Struc.) $1,500,000. Client, Sam Hutchings, Arch.

Hospital complex, Thermopolis, Wyo. (Civil, struc.) $1,000,000. Client, Fisher, Fisher & Davis, Arch., Denver, Colo.

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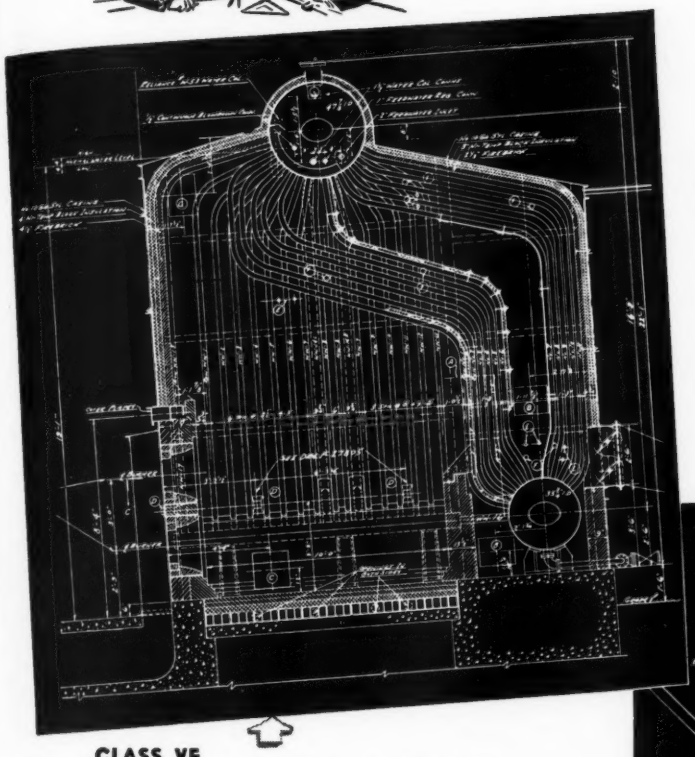

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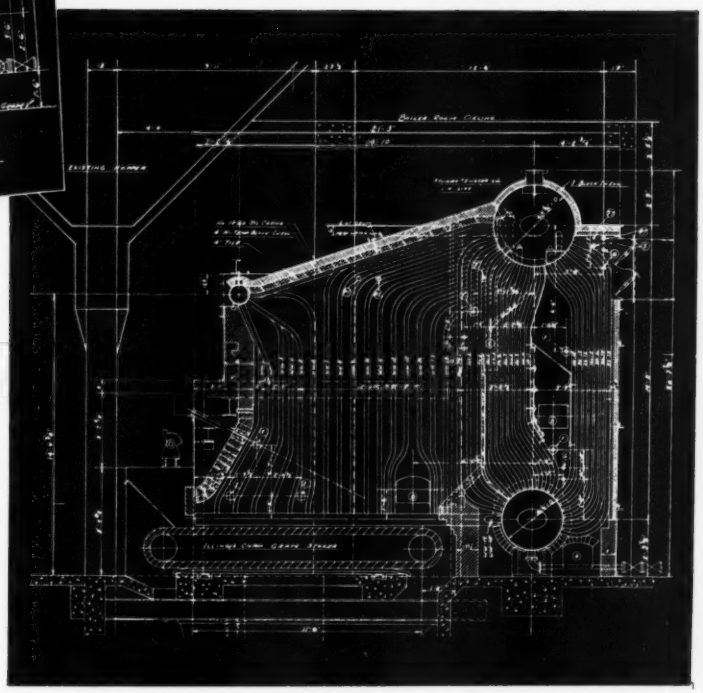

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Books

For

Consulting Engineers

PUMP SELECTION AND APPLICATION, by Tyler G. Hicks; McGraw-Hill Book Co., Inc.; 422 pp.; $8.50.

Reviewed by
Robert I. Schoof
Chief, Mechanical Engineering Dept.
Rader and Associates

Mr. Hicks, in his book, has attempted to supply engineers, specification writers, and designers, in every field in which pump and pumping problems arise, with a comprehensive study of the factors that determine the proper selection and application of pumps. Mr. Hicks, who is Special Projects Editor, *Power* magazine and instructor in mechanical engineering, Cooper Union School of Engineering, has drawn upon many pump manufacturers as well as the Hydraulic Institute publications for contributions such as photographs, characteristic curves, tables, and other data. In this way he has presented in a logical form a composite of the works of many pump experts, thus providing an informative textbook for students as well as a convenient reference for consulting engineers and designers.

Part 1 of the book, entitled "Pump Classes and Types," outlines the classification of the basic pump types; centrifugal, rotary, and reciprocating; and then leads into a discussion of the pump action, characteristics, applications, materials, and physical descriptions of each.

Part 2, "Pump Selection," is divided into seven chapters — each dealing with the factors affecting the economical and efficient selection of the proper pump. This part includes discussions on suction and discharge heads, their computations, their effects, cavitation, pumps in parallel and series, pump capacities, capacity control, and throttling effects.

Piping systems and their effects on pump operation, as well as complete descriptions of various types of driving mechanisms also are included. The inclusion of charts, graphs, and tables, as well as illustrative examples throughout this portion of the book, is beneficial to the engineer who is concerned more with specific problems of fluid flow than with detailed theories.

This section on pump selection rightly is completed with a chapter that details factors influencing pumping economics. Here Mr. Hicks touches only lightly on the basic concepts on engineering economy, stressing instead practical pumping problems with useful tables and other data.

Part 3, "Pump Application," devotes an entire chapter to each of fourteen industries in which pumping problems arise. These include power plant, nuclear energy, petroleum, chemical, food, and paper industries as well as water supply, sewage, irrigation, air conditioning, mining, construction, marine, and hydraulic applications.

Each of the chapters describes specific problems and solutions for given jobs in each field, detailing expected service conditions and types of pump or pumps suitable.

•

STRESS CORROSION CRACKING AND EMBRITTLEMENT, edited by William D. Robertson; John Wiley & Sons, Inc.; 202 pp.; $7.50.

Reviewed by
Dr. Sidney Sussman
Water Service Laboratories, Inc.

This book, presenting fourteen papers originally given at the Symposium on Stress Corrosion Cracking at the Boston meeting of the Corrosion Division of the Electrochemical Society in October 1954, is essentially a progress report on the mechanism of stress corrosion cracking for the decade 1944-1954. Although probably of little direct application in the work of the average consulting engineer, it will be of background interest, and perhaps

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Excerpt from article in *Modern Sanitation* Magazine.

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Address.....

more, to those engineers whose practice includes metallurgy and selection of materials of construction.

The subject is becoming more important to materials engineers of all types as we push further into the realm of higher temperatures, pressures, and mechanical stresses, while at the same time seeking longer life so that equipment can be used for continuous operation over long periods of time. Possibly the most important single statement in this book from the point of view of designers in the fields of welding, chemical process equipment for high pressures, aircraft, boilers, and nuclear power equipment is that by Robertson and Bakish (page 32) that "positive conclusions, of sufficient generality to provide a basis for prediction about the behavior of new alloys, or old alloys in new environments, are still lacking."

For those who might want a brief introduction to the subject without digging into some of the more specialized or more theoretical papers, the first paper by J. J. Harwood of the Metallurgy Branch, Office of Naval Research, and that by U. R. Evans of the Department of Metallurgy, University of Cambridge, provide a background on the mechanism of stress cracking, while the early pages of the last chapter by H. R. Copson of International Nickel Company's Research Laboratory are particularly useful in summarizing some of the metal-environment combinations that have produced this type of failure.

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SEWAGE TREATMENT, 2nd Ed., by Karl Imhoff and Gordon M. Fair; John Wiley & Sons, Inc.; 338 pp.; $7.50.

Reviewed by
John R. Snell, Partner
Michigan Associates,
Consulting Engineers

This book is an excellent example of how it is possible to take a very complex subject and reduce it to simple concise terms and examples. Written by the deans of sanitary engineering in Europe and the United States as co-authors, the book covers the requirements and practices of North American municipalities and industries in the field of sewage treatment and disposal. Simple arithmetic calculations are employed in place of calculus, and generalized average quantities, analysis, and values have replaced masses of statistical data from particular plants and cities. Many example problems are used to illustrate the theoretical principles described in the text.

This second edition is rewritten and up-to-date, and not just a re-editing of the first edition. An excellent bibliography is given in the Appendix for each area of interest.

My personal experience with the first edition indicates that this book is a valuable tool for sanitary engineers and municipal engineers alike. No matter with which phase of the engineering profession one is connected, the book has much to offer as a ready reference. The book is intended for an entirely different purpose than the thousand page reference book by Fair and Guyer, entitled, *Water Supply and Waste Water Disposal.* The author knows of no other book where so much information has been condensed to such a concise and simple form as has been accomplished by these two world authorities.

ALSO AVAILABLE

HIGH PRESSURE TECHNOLOGY, by Edward W. Comings; McGraw-Hill Book Co., Inc.; 572 pp.; $11.50.

The central theme of this book is the influence of elevated pressure on chemical and physical systems, and on the design of equipment for handling these systems experimentally or on a commercial scale. Extensive appendixes supply data for problems, calculations, and design. A glossary of unusual words and terms in this field is included.

After an introductory chapter, a number of chemical processes are listed and described briefly by R. Norris Shreve to point out the applications of the other chapters. Following this, H. C. Van Ness contributes an introduction to the principles governing the properties of metals, which provides a basis for the selection and treatment of metals and alloys for use in high pressure equipment.

Subsequent chapters deal with procedures and suggestions for safety practices; with the principles of design of many types of high pressure equipment; with the stresses and strains in thick-walled cylinders and their design limitations; with selected examples of apparatus and techniques used in measuring the properties of matter at high pressures and in conducting chemical reactions; with the effect of pressure on gases and liquids and the application of thermodynamics to single and multi-phase systems; with the effect of pressure on chemical equilibrium; and with the principles of design of chemical reactors as a background for the special application to high pressure reactors.

The final chapter provides a relatively extensive discussion of the process for the synthesis of ammonia, which was selected as an example of a high pressure chemical process.

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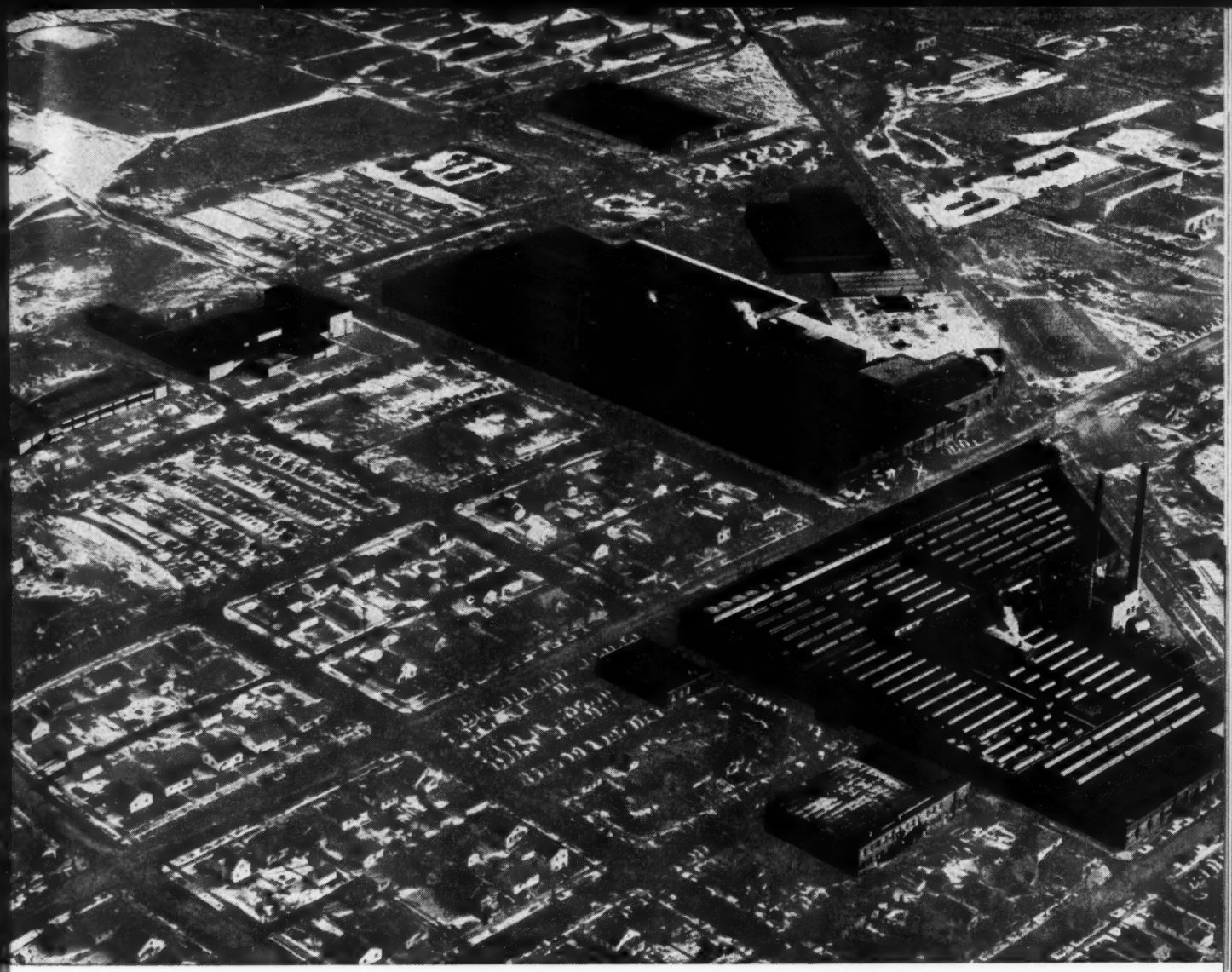
APPLIED METALLURGY FOR ENGINEERS, by Malcolm S. Burton; McGraw-Hill Book Co., Inc.; 407 pp.; $7.50.

The purpose of this book is twofold: to develop the metallurgical principles involved in casting, metal working, welding, heat treatment, and powder metallurgy; and to study these manufacturing processes from



Trane saves $27,000 a year burning coal the modern way

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CORROSION: A COMPILATION, by Dr. Mars G. Fontana; Hollenback Press.

This is a compilation of the monthly columns on corrosion written during the past ten years for *Industrial and Engineering Chemistry*. The articles are grouped into seven chapters:

Nature and Extent
Eight Forms of Corrosion
Eight Methods for Combating Corrosion
Corrosion Testing and Evaluation
Materials
Environments
High Temperature Oxidation

Practically all metals and alloys and some non-metallics used for corrosion applications are covered, with descriptions of methods and detailed procedures for testing. Corrosion also is shown as a function of temperature and concentration of acids through iso-corrosion charts.

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PROCEDURE HANDBOOK OF ARC WELDING DESIGN AND PRACTICE, 11th Ed.; The Lincoln Arc Welding Co.; 1300 pp.; $3.50.

A major portion of this well known reference book has been rewritten for this edition. Contents range from the early history of arc welding to modern structural design. Each of the eight sections—history, nomenclature and processes, weldability, mild steel procedures, manufacturing cost data, machine design, structural design, applications, and reference data—has table of contents.

The structural section discusses the theory and application of the rigid frame and plastic design systems, with details on the design of structural members and joints. A group of charts and nomographs simplify design calculations and applicable codes have been condensed to usable size.

The machine design section presents an entire machine design system which directs the designer from his starting point of "what the machine must do" to a completed design. The system is a logical procedure insuring consideration of all pertinent factors and leading to an economical design that includes the right amount of material.

FILMS

"ALUMINUM ON THE MARCH," Reynolds Metals Co., sound and color, 16 mm, 28 minutes.

This film deals with the ever widening uses of aluminum in every phase of modern day living. It goes from bauxite mines to rolling mills, showing how aluminum is mined, reduced from powder to metal, cast, rolled, extruded, pressed, coiled, and shaped into products ranging from packaging foil to airplane wings.

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"ALUMINUM IN MODERN ARCHITECTURE," Reynolds Metals Co., black and white, 16 mm, 13½ minutes.

This is a camera report of how aluminum architectural products are changing concepts of design for churches, schools, offices, factories, auditoriums and homes.

•

"THE BIG DIFFERENCE," Superior Steel & Malleable Castings Co., sound and color, 16 mm, 16 minutes.

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